

SCIENTIFIC AMERICAN

SUPPLEMENT. No. 1212

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Scientific American established 1845.

Scientific American Supplement, Vol. XLVII, No. 1212

NEW YORK, MARCH 25, 1899.

Scientific American Supplement, \$5 a year.

Scientific American and Supplement, \$7 a year.

EXCAVATIONS IN THE ROMAN FORUM.

THE excavations in the Forum have been steadily continued under Signor Baccelli. The exploration of the foundations of the Temple of Vesta is completed.

After clearing away the encumbering earth, brick walls were found. These, built in the center of the mound, were four in number. The one on the western side had been destroyed in some past age. The others seem, from the excellent character of the work, to be

of the time of Hadrian; but as no stamped bricks were found, it is not possible to be absolutely sure of the date. Near the bottom of the chamber formed by the walls a brick with the words *Ree Du Theodorico Hono* Rome came to light. This, however, did not belong to



Minister of Public Instruction Signor Baccelli.



View of the Forum in its present condition.
Exterior of the Tomb of Romulus.
Excavations near the Temple of Julius Caesar.



Interior of the Tomb of Romulus.
General view of the Tomb of Romulus.
Fragment of a votive column to Julius Caesar.

NEW EXCAVATIONS IN THE ROMAN FORUM AND DISCOVERY OF THE TOMB OF ROMULUS.

the walls, but is evidence that, as was the case in respect to many other buildings in Rome, Theodorici interested himself in the preservation of the Temple of Vesta. What purpose was served by the walls cannot be told. Were they built by Hadrian to support the superstructure, or did they form a chamber for the ashes of the sacred fire which were taken off once a year and thrown away by the Porta Stercoraria? Of small objects few were found. A splendid boar's tusk and one or two Roman bronze coins of late date were turned up. Much more numerous were the fragments of vases ranging in date from our own times to the end of the fifth century before Christ. These shards were, as a whole, of but little value, but among them was one small piece that is of sufficient interest to make up for the dullness of all the rest. It is a bit of a Greek red figured vase of the end of the "strong" style, and shows the figures of two warriors in combat. It was found deep down among the foundations. Its interest is in the suggestion it affords that such were the vases used by the Vestals for their own needs and those of the goddess. How else could such a fragment have got so deep down below the temple?

Such has proved to be what Lanciani (to mention only one, but he the latest, among many writers on the subject) described as "a shapeless mass of concrete."

What will first strike the attention of whoever now, returning to Rome, goes to the Forum, is the Honorary Column. Once more it stands erect and fulfills its purpose; for though we do not know to whom it was originally set up, it serves henceforth as an honorable monument to Minister Baccelli and to his "braccia destra," Signor Boni, without whom its disdained fragments would still be cluttering the ground. There is no question that the column stood originally not directly on the existing brick base, but, like the Column of Phocas, on a marble pedestal placed between the base and the shaft. This pedestal has not been found. Consequently, some were in favor of doing nothing about the column, while others thought it had best be placed directly on the brick base. Fortunately, neither of these courses was followed, but a pedestal of brick was made of the same proportions as the pedestal of the Column of Phocas, and on this the column stands. This is, clearly, the proper solution of the question. To erect the column on the base without any pedestal would have been to make an architectural abortion which no one with any understanding of architecture could advise. As in the case of the brick support of the adicula of the Atrium Vestæ, this brick pedestal is not a restoration or in any way deceptive. It merely serves to set the column in its proper relation to the base and to the neighboring buildings.

A work that does not attract much visual attention, but which adds greatly to the attractiveness of the Forum, is the closure of the opening made by Rosa years ago into the Cloaca Maxima at the eastern end of the Basilica Julia. The constant stench that arose from the sewer made the neighborhood disgusting, and the only reason for the original making of the hole, or for now leaving it, was that inquisitive tourists might look at this ancient drain. There are so many opportunities for the satisfaction of the "yellow" curiosity that enjoys such sights that this hole seemed needless, and it required only a few moments' consideration on the spot to convince Minister Baccelli that it had best be closed.

Another small but much required undertaking was the insertion of some iron bars in the base of the Temple of Saturn to clamp together the blocks which showed ominous signs of giving way and letting the superstructure crash down. Signor Boni has seen to this, and the temple is safe for a long time to come.

So far I have described matters of importance, but in no way surprising or exciting. Two discoveries, however, have been made, the interest attaching to which could scarcely be surpassed in connection with the history of Rome. One of these is the base of the column set up where Caesar's body was burned, and one the "black stone" which was supposed to mark the burial place of Romulus. For what more could one ask? After the exploration of the Temple of Vesta was completed, Signor Boni turned his attention to the Temple of Caesar. As all who have studied the topography of the Forum will remember, Suetonius tells of a column of Numidian marble (what we call giallo antico) dedicated parenti patriæ on the spot where Caesar was burned. An altar also was placed there, but this was destroyed because the worship of Caesar was illegal. Afterward, Augustus built, as he tells us in his autobiographical inscription, the Temple of Julius. Later authors say that the temple stood on the site of the funeral pyre, and it is scarcely conceivable that Augustus should have destroyed the column. Those who know the Forum will recall that in the front wall of the podium of the Temple of Julius there is a semicircular recess, in front of which stands a wall of tufa. This tufa wall does not close the recess to all access, but merely makes it necessary to enter from the sides. The wall is of late origin, probably, to judge from the construction, of the third or fourth century of our era. If there was one spot where more than anywhere else one would have sought for traces of the marble column, it was in the space between this late wall and the inexplicable hemicycle. It is well nigh incredible, but it is the fact, that when some time ago this spot was excavated, only a few bushes of earth were taken away at one end of the wall, and the space between it and the hemicycle left absolutely unexplored! Signor Boni has now cleared away the earth, and there, on a pavement of well cut travertine blocks, are the remains of a base such as one would expect the column to have had. This is the pavement which Caesar trod. Here is the very spot where once his body rested. Here Antony aroused the deeper emotions of the plebs, and here from the phoenix ashes of a dead republic rose the young empire.

Only the core of the base is left, and the marble that originally covered it has disappeared—stolen, no doubt, in the sixteenth century by one or other of the architects who used the Forum as a quarry. This core is noteworthy, for it is made of fragments of giallo antico and gray Carrara (lunense) mixed with pozzolana—these chips being, most probably, those made by the workers on the column; for giallo antico was not a common marble, and lunense was rare in those days. Pliny says that M. Lepidus, a consul in 676 A. U. C., was the first to introduce the giallo, while Mamurra, one of Caesar's officers, first used lunense in large pieces.

To many persons the so-called Tomb of Romulus will be of quite as great interest as the site of Caesar's funeral pyre. The ancient authors give us but scanty information about the tomb. What they say, though slight, is perfectly clear. Festus, under the words *niger lapis*, writes that there was a "black stone in the Comitium which showed where there was a grave;" some thought this had been intended for Romulus; he, of course, was never buried, and, after his disappearance, the grave was used for Faustulus and Quinctilius. These statements are borne out by the scholiasts on a verse of one of the Epodes of Horace (xvi., 13), who say that Varro wrote that the Tomb of Romulus was before the Rostre, where, also, two lions stood. One of the scholiasts quotes Varro as saying not before but behind the Rostre. For various topographical reasons, this must be a mistake. A few days ago this "black stone" was found. Signor Boni had for some days been exploring the late branch of the Sacred Way that ran from the Arch of Severus to the Temple of Faustina. In the neighborhood of the arch there was an opportunity to enlarge the extent of the explorations, and very soon a well laid travertine pavement of the republican epoch was found. It was in close proximity to the spot on which the buildings of the Comitium stood, and this pavement is part of that of the Comitium. Hardly had it been discovered when the workmen came upon a travertine curb. Further digging showed that this curb protected a black stone. This has now been entirely uncovered, and turns out to be a small pavement, about twelve feet square, of black marble blocks (19-25 cm. thick), protected on all four sides by the travertine curb, the latter, however, not entirely preserved. This is sufficiently strange, but what proves the sanctity of the site is that, when (probably in the fifth century A. D.) the road was built that now runs from the Arch of Severus over the spot, large marble slabs were raised like a solid fence all about the black stones to protect them. The blocks of the pavement, which are not absolutely regular in form, are of the black marble streaked with white that comes from Tivoli—what the modern scapellini call *marmo nero di Grecia*. For the present they have been partially covered up, as the attacks of relic hunters began instantly after the announcement of the discovery, and the authorities do not desire fresh confirmation of Horace's words:

"quæque carent ventis et solibus omnia Quirini, nefas videre: dissipabit insolens."

Not only is this *niger lapis* of great interest in itself, but we now know more accurately than ever before the approximate position of many of the most sacred monuments of Rome, for close to the tomb of Romulus was the statue of the wolf suckling the two brothers, and the Nævian fig tree planted by Tarquinius Priscus over the spot where he had buried the stone which Nævius cut in two with a razor.

Since the discovery of the metope of the Basilica Emilia, several other objects of a similar nature have been found. One, most interesting because the first of its kind known, is a piece of one of the windows of the second story of the Basilica Julia. This had been discarded by the previous excavators as of no interest. Considering that they thought so little of the metope of the Basilica Emilia as to build it into the retaining wall of a road, it is not surprising that they did not realize the value of a piece of window frame. There are, in truth, no terms of contempt too strong to characterize the work that has been done before this year in the Forum and that which is still being done in other parts of Italy. Were it worth while, proofs of such mismanagement, carelessness, and self-seeking could be given that those hearing them might think they were listening to tales of Turkey.

The discovery of such pieces as the metope suggests two things that it is greatly to be hoped Minister Baccelli will successfully accomplish. One of these has been already undertaken: it is the taking over from the Church of the Temple of Romulus, which, freed from late additions and put in its original shape, so far as may be, will then serve as a museum for all objects found in the Forum, and others, such as photographs or engravings or casts, that are connected with it. Here ought to be put the statues of the Vestals found in the Atrium Vestæ and now in the Museo delle Terme. Where they now stand they are lifeless objects—dead archaeological facts, material statistics. In the Forum near where they were originally placed, they would acquire some faint impulse of life, and render the Forum and Roman history more truly intelligible than it now is even to those few who are blessed with the power of imagination.

The other suggestion given by the present work is that the minister arrange for the excavation of the northern side of the Forum, which is entirely disused except for a loop in the track of the electric tram—a loop which, with no difficulty whatever, could be run along the road beside S. Adriano. This undertaking would be worthy of him. To do what has so far been done required no intelligence; the results have all been got by merely removing earth that plainly was out of place. It will take some thought and trouble to carry out the further excavation here suggested, but it will have to be done some day. Minister Baccelli might as well pluck the laurel as leave it. Then, too, the ground where the Capitoline plan was found ought to be excavated. It never has been. A mere ditch, a few feet broad, was dug at the foot of the wall on which the plan was originally fastened. If the earth, not only a few feet, but a few yards away from the wall were searched, other pieces of the plan would, in all probability, be found. That game is assuredly worth the candle.—For our text we are indebted to "R. N.," the correspondent of The New York Nation, and for our engravings to Ueber Land und Meer.

THE GOLD MINES OF WEST AFRICA.*

By JAMES IRVINE, F.R.G.S.

UNLIKE the Transvaal and Westralia of to-day, or the California and Australia of fifty years ago, the Gold Coast of Africa has a history, which it is necessary should be understood and remembered in order to appreciate fully its importance now; and, with your permission, I propose to give a brief sketch of that history, although I am aware that to many of you I shall not be able to unfold anything new.

* A paper read before the Society of Arts, and published in the Journal of the Society of Arts.

The first records we have of gold in that part of the world take us back to the days of Herodotus, the "father of history," some 450 B. C., who tells us that the Carthaginians obtained their supplies of gold from black people who brought it across the great desert from the western shores of the continent; and he thus, in an unintentionally amusing manner, describes the trade by sea which was then carried on:

"There is a nation beyond the Pillars of Hercules which they are wont to visit, where they no sooner arrive but forthwith they break cargo, and having disposed their wares in an orderly way along the beach, leave them, and returning aboard their ships raise a great smoke. The natives when they see the smoke come down to the shore, and laying out to view as much gold as they think the worth of the wares, withdraw themselves afar. The Carthaginians upon this come ashore and look. If they think the gold sufficient, they take it and go their way, but if it does not seem enough, they go on board once more and wait patiently. Then the others draw near and add to their gold till the Carthaginians are content. Neither party deals unfairly with the other, for they themselves never touch the gold till it comes up to the worth of the goods, nor do the natives even carry off the goods till the gold is taken away."

And evidence of this early trade is also said to be supported by other writers upon this part of the world, though whether they describe it in the same glowing terms of simplicity and goodwill I cannot say. It is very clear that those days are far removed from ours, with their "grabbing" of hinterlands and keen jealousies between race and race.

I shall not, however, detain you over those far-away histories and these modern moralities, but bring you down to a comparatively recent period, though even here we are forced to go back to the early fourteenth century, when the French were said to have recommenced the trade in gold with the natives then resident at Elmina; just one hundred years before the arrival of the Portuguese.

Whether the claims of the French are good or not, it is certain that the Portuguese under Baldeza brought gold in 1482, and that in 1470 other navigators brought supplies of it from the mouth of the Pra; also about this period another Portuguese merchant, Fernando Gomez, bought the monopoly of trading in gold dust for five years for the sum of £50 a year, and on giving an undertaking to explore annually a line of 350 miles of coast.

This exploration led to the opening of large and important mines, to defend which it is assumed that the Castle of Elmina was built, and a flourishing trade was carried on till early in the seventeenth century, when the mines were shut down and the digging of gold made fetid by the king, since which time no gold has been worked in that neighborhood. This trade was continued in gold and slaves from other districts of the Gold Coast until Guinea became the great gold producing area of the old world. This name of Guinea, which gave the designation to our 21s. piece on account of the mineral from which it was made coming from this district, is supposed to have arisen ages before from the natives of Jenna on the Niger, who traded in large numbers with the Gold Coast, and when asked by the Europeans from which place they came, replied Jenna, or Genna.

The first Englishman who brought away the precious metal was Captain Thomas Wyndham, who, in 1581, brought to England 150 pounds weight of gold dust, worth about £10,000. This result so encouraged the merchants of those days that they fitted up three vessels, the "Trinity" and the "John Evangelist," each of 140 tons, and the "Bartholomew," of 90 tons, and these three vessels returned with gold, ivory, and grains of Paradise, valued at £34,100, and some slaves.

Stories of sensational riches come down to us from those ages, and the barbaric splendor of some of its past rulers freely justify such traditions. Ghana was famous among the ancients for its golden throne, Bontuko for its golden stool, while Bowditch tells us that the king of Gama, of which Bontuko was the capital, had steps of solid gold by which he ascended to his bed. The Ashantis were most proficient in the manufacture of ornaments made from gold, but were surpassed by the people of Dagumba, who inhabited a large territory to the northeast of Ashanti, ornaments being made in weight to the extent of more than 1,000 ounces.

To conclude this part of my subject, the particulars of which I have freely used from the pages of Bowditch, of Ellis, and of MacDonald, I will quote from the late Sir Richard Burton in his book, "Wanderings in West Africa." Sir Richard says that about this period, cupidity having mastered terror of the Papal bull which had assigned to Portugal the exclusive right to this trade, English, French, and Dutch adventurers hastened, early in the sixteenth century, to share the spoils, when a flood of gold poured into the lap of Europe, and as much as £3,000,000 was shipped from Elmina alone early in the eighteenth century. Sir Richard also says, and upon this I shall have some remarks to make later on, that as we advance northward from the Gold Coast the yield becomes richer, and that in Ashanti the red and loamy soil, scattered with gravel and gray granite, is everywhere impregnated with gold.

I now come to the present day, and it is to Sir Richard Burton we are indebted, more than to any other man, for drawing public attention once again to this ancient gold-field. In 1863 was published the book I have already named, "Wanderings in West Africa," to be succeeded by his joint work with Commander Cameron, C.B., entitled, "To the Gold Coast for Gold," and published in 1882. In both of these books he expressed his amazement that the intelligence and enterprise of the present day had not sent men and machinery, for he it remembered all the wealth described had been obtained in the most primitive manner by surface washings, or by pounding the quartz by hand, which had been obtained from shafts rarely exceeding 50 feet in depth—at which depth the natives, having not the smallest idea of pumps or modern machinery of any sort, were invariably drowned out.

In parenthesis I may say that all the merchants trading to the entire West Coast of Africa, notably Messrs. Swanzy & Company, who testified in a Blue-book fifteen years ago that their firm had received in exchange for English manufactures not less than

\$1,000,000 in gold dust, were aware of this vast wealth, but no steps, as I have said, had ever been taken scientifically to develop the mines until about the years 1880 to 1882. At that period several companies were started, most of them with totally insufficient capital, and the few which had enough had neither experienced men to guide them nor scientific knowledge of any kind on their boards, and the result was natural and inevitable.

There is this to be said, however, in defense of the management at that period, that really trustworthy experts and managers were few and far between. Gold mining had not become the science it is to-day, for all will admit that knowledge in this respect has been obtained by leaps and bounds during the last ten to fifteen years, and an enterprise which can now deal with the Banket formation of the Wassau Reef with as much precision and with as great security as with a well defined coal formation in Northumberland had not then been thought of. It is also to be remembered that East Indian gold mining, and the early days of the Transvaal, were calling for all the experienced managers, and that West Africa with its evil name came in as a bad third, only getting men who, as a rule, could not find employment elsewhere; nevertheless those pioneer days, full of misfortune to many shareholders, and discredited, often very undeserved, to others, had their use, and the workers of the present are entering into their labors and reaping the fruits. In this manner, not one single company which afterward came to grief did so because they found no gold—absolutely every one found gold, ranging from so many dwts. on the surface to 9 oz. at greater depth, and as 8 dwts. cover all working expenses. It passed beyond question that with capital to develop, every mine would pay dividends in time. Unfortunately, however, in each instance the capital, often, as I have already said, too small, had become exhausted at a time when the entire commercial world was in a backwater of depression, caused partly by these losses (less in Africa, however, than in India), but still more by the political unrest which has weighed so very heavily on all legitimate enterprise during the last ten or fifteen years.

But all African gold companies did not then fail. Some held their ground through good management, and the use of money advanced by those who had the power and who believed in a great future. The result is that we have one company which gave an average yield last year of 28 dwts., with crushings of about 6,000 tons of conglomerate, and which has an estimated amount of gold of £5,000,000 sterling, to all intents and purposes proved.

At a meeting of the Geological Society of London, held on the 20th April last, a paper was read on the origin of the Wassau conglomerates, and in the discussion which followed, an experienced authority on the subject said he did not agree with the reader of the paper in thinking that the West African conglomerates were derived from the disintegration of the existing range of mountains which were found a little further inland, but he thought they undoubtedly belonged to a far earlier period, and were similar in age to those in South Africa. They were evidently part of the series of sedimentary deposits which so largely predominate over the surface of the African continent. He thought that in these conglomerate beds of West Africa there would be found to be deposits as extensive and as rich in gold as those of South Africa.

Regarding this property just referred to, one of the directors, whose experience and whose character give weight to his opinion, said, publicly, in July last: "I am looking to the time when, like the Crown Reef, we shall be paying 200 per cent.; their stuff is very much poorer than ours."

Another company, under continuous crushings since June of last year, has given an average of over 1½ ounces to the ton, but, so far as I know, the directors of which have not ventured on an estimate of their gold in sight; another which has held up its head since 1880 has obtained an average of fully 1 ounce to the ton, with many thousands of tons crushed; another, the gold of which was so pure that 84s. per ounce was offered, or if the quartz could be shipped home uncrushed, the smelters at Swansea agreed to buy it at £20 6s. per ton on the standards of samples assayed.

It may not be out of place to recall Sir John Glover's statement, made in the Town Hall of Liverpool on his return from the Ashanti war of 1874, that on that splendid march of his from the Volta to Kumassi he passed through districts where you could dig up gold as you would dig up potatoes. Some of us heard that statement, and Sir John was not given to exaggeration, though, of course, in this there was allowably some hyperbole. I can make many other similar statements regarding the value of the West African reefs, for which I hold documentary proof, but these will suffice.

I am not here to advertise any single mine, but I am pleased to have the opportunity of drawing attention to the phenomenal richness of the mining districts on the Gold Coast of Africa, and to state as my well-founded conviction that we are on the eve of a success which has probably no parallel in the history of any era or of any colony.

I said in a previous part of my address that I would refer to Ashanti. This kingdom, as you all know, has only recently come under the government of Great Britain, and sufficient time has not been afforded for the same amount of development, but what development has taken place has been absolutely surprising. About two years ago a concession was obtained which left no doubt about the richness, and as the capital—in this case not too small—was easily obtained, steps were at once taken to send out and erect machinery, with the result that a reef 25 feet wide was attacked, not by expensive shafts, but as a quarry, and crushings of many hundreds of tons have yielded an average of three ounces to the ton; indeed, a well-authenticated rumor has it that at this very moment they are crushing quartz which is giving eight ounces to the ton.

Another property which adjoins it was inspected and reported upon by an expert of high standing, but his story was considered so improbable that a second mining engineer, of experience and probity, was sent out at great expense, and he not only confirmed the previous report, but placed an actual estimate upon the property, valuing the amount of gold easily recoverable at £2,000,000 sterling.

M. MacDonald, from whom I have already quoted,

estimates, at page 112 in his book, that gold to the value of not less than £800,000,000 to £700,000,000 had from time to time come out of the Gold Coast.

I feel sure I must in this hasty review have said enough to prove the enormous richness in gold, and that the name of the Gold Coast is a correct description of the territory.

I shall now proceed to speak of the titles under which these concessions are held. The properties are, in the first instance, obtained from the chiefs who have, by native consent and approval, owned them for generations—by purchase, or by the payment of an annual rental, or by royalty on the gold won. A regular deed, with all the formality and tautology of a similar document in England, is drawn up and signed in the presence of the English district commissioner, who explains, through an interpreter, the meaning of it, and who then affixes his seal to a statement that the vendor clearly understands its import; the deed is then taken to the duly appointed English official and registered. In the main this has answered very well in the past, though difficulties not infrequently arise afterward, when other natives come forward to say that the first vendors did not own this property—but I have never known a case where the English purchaser had to give it up, as with tact and reasonableness every native can be dealt with.

These cases and other points, such as the possible overlapping of properties, have, however, led the government to see the necessity of guiding and controlling such native grants, and a Lands Ordinance Act has therefore been under arrangement for some time; and that one will be passed after due consideration, but not until due consideration has been given to it, not by government officials only, is the desire of everyone.

In this connection I may state that considerable anxiety was caused by the proposed Lands Bill of the late governor, which, however, fortunately was rejected by Mr. Chamberlain, who assured a deputation of native traders sent over to this country to represent native interests, that the future bill would be framed on just and equitable lines, and acknowledging the laws dating from time immemorial of the native kings, chiefs, and families; a full report of this interview is to be found in a large pamphlet published on August 3, last, by Messrs. Ashurst, Morris, Crisp & Company, the solicitors representing the deputation, and I am pleased to be enabled to quote from a letter which I received a few days ago from Cape Coast Castle, as follows:

"To-day there was a mass meeting in the Chapel Square to receive the message from the representatives of the aborigines who went to England over the Lands Bill. By what I can understand, everything is settled amicably for them, and the kings retain their right to sell or dispose of their lands as they think fit; the government recognizing the native customary laws."

Let me now speak of that all-important question of climate, which has so far been the greatest, perhaps the only real difficulty, and that it is a difficulty of grave and sad importance no one will deny.

The experience of everyone during the last ten or fifteen years has unfortunately been that the engineer-in-chief after six or twelve months at his mine, if he has not died, has sickened and fled, and another, after perhaps weeks or months of anxiety on the part of boards in England, has been found, sent out, and in many instances with the same result, until despair has well nigh broken the heart of every director; but that all this has come from the climate itself is far from the truth—much, perhaps one-half, of the illness has been caused by the men themselves. I had the misfortune to know one case in point where the directors of a company waited for six months to get one particularly experienced man whom they brought home from Venezuela, but whose character had undergone sad deterioration since the chairman had last seen him. This man drank thirty-four bottles of brandy, champagne, and beer on his journey of twenty-four days, landed drunk, lived drunk, and in twenty-one days died drunk, and the climate got the blame. This is an extreme case, but cases half as bad, or even one-fourth as bad are common and bad enough, and it is this more than the climate itself which gives the character to West Africa.

I do not hesitate to say, and there are gentlemen in this room who by practical experience of years can bear me out, that given sobriety, common sense, and plenty of work to do, with the best food and the best quarters which money can procure, the climate of West Africa is not one whit worse than many other of our tropical possessions. The experience of one important company is worth giving here in support of my last remark. This company has been working successfully, and during the last ten years has only had four deaths directly due to the climate and two others indirectly due to the same cause.

Then I ought also to point out that the mortality and sickness, especially of late years, has, I think, been largely among government officials; it is, therefore, much more in evidence. This is to be traced to two extremes of life: one which calls for our respect, admiration, and sympathy in the lives of those grand fellows, most of them young, who are the makers of our empire, and who are forced to bear hardships of exposure, of irregular and of insufficient food, and who, without a murmur, endure, do their life-work—and die. The other extreme is thus referred to by Mr. MacDonald, in that capital book of his, from which I have already quoted:

"So the Gold Coast has gone on from year to year with its death-rate much about the same."

Work in the same department, limited occupation, scanty amusements, poor and insanitary quarters, have all contributed to keep up the bad name of the colony, and to embarrass commercial progress in one of the richest of our tropical possessions.

But these conditions are not going to continue. They are not a necessity of West Africa, and they are already disappearing; already we are finding a very different class of engineers and miners, partly because we have, owing to the increase of the mining industries of the world, which afford schools of education, a much larger and a more respectable field from which to choose our managers and men, and partly because of the attention drawn to the question of health.

In this connection it is fitting that I should refer here to the magnificent offer of the president of the African

Section of the Liverpool Chamber of Commerce, Mr. A. L. Jones, who has undertaken to give an annual grant of £400 to cover, in Liverpool, the cost of research into the origin of malarial fevers, and it is perfectly reasonable that we should look for such an improvement in the sanitary condition of West Africa as we have had, say, in Calcutta, under which our young men of the next generation will prefer Africa to India.

What do we find was the condition of Calcutta when that city of palaces and of wealth was founded? Sir William Hunter says in his delightful book, "The Thackerays in India:" "Our ancestors found Calcutta a swamp, and they created on it a capital; and this is the description of it. After stating that one or two families of Sets and Baisaks, just as one would say one or two families of Bonny men, Calabrese or Fantes, settled at the Cotton Mart overlooking the river, he adds: "That bank sloped down into a swampy jungle which at places came right down to the river's edge, at others there was a strip of fairly raised ground between the river and the swamp, and behind it spread the vast agglomeration of brackish lagoons, a pestilential region, long given up to the tiger and the crocodile." "By creeks, through the narrow strip of high ground along the river bank, the fetid ooze from these fens swayed backward and forward with the rise and fall of the tide." This description, which those of you who know West Africa would consider an exaggerated one for even the worst part of it, is what Calcutta was at its foundation, and which, as late as 1757, gave the result mentioned in a letter from the admiral's surgeon, when he reported that "of the 250 soldiers who came with Kilpatrick in August of the previous year, only five survived their commander."

Another authority—Rennell—speaks of it as a climate which proved so prejudicial to European constitutions that scarcely one out of seventy men returned to his native country.

This is what Calcutta was only a few generations ago, infinitely worse than anything we have ever had in West Africa, except, perhaps, in the epidemic which visited "the rivers" in 1890, or thereabout, and we are entitled, therefore, to hold the conviction that, with the superior knowledge and appliances of the present day, we shall have a state of things, and at no distant date, which will raise the health of West Africa to a level of that rejoiced in by the thousands of our countrymen in India.

I must now bring this paper to a close, but I cannot do so without acknowledging our indebtedness to Mr. Chamberlain for the extreme interest he has taken in the development of this part of our colonial empire. It is true that he is only carrying out the resolution come to by Lord Ripon, his predecessor in the last Liberal Government, who pledged himself to the extension of railways and other developments; but none the less, or perhaps all the more, do we feel our indebtedness to him, and it is fitting we should state that he has not only met every deputation and every request with the accustomed courtesy of the Colonial Office, but what is not so usual, he has fulfilled his promises, and has given a fostering hand to every scheme which has had for its end the welfare and the advancement of this part of Her Majesty's dominions.

It is with pleasure I quote from his speech at Manchester on the 10th of November last, on which occasion he is reported to have said:

"We had secured a sufficient hinterland for our colonies on the Gold Coast and at Lagos, and he ventured, standing here, to predict that before five years were over those colonies would be among the most valuable possessions of the empire."

I now very briefly refer to the railway so happily begun from Secunder to proceed to the Wassau Reef, and thereafter to Kumassi along a gold belt unequalled in its richness in the whole world. That this line will pay from its opening day there cannot be an atom of doubt, for there are a dozen mines—I might well say dozens of mines—waiting to begin operations until they can get up their machinery and material at profitable rates. At present the cost of transport ranges from £18 to £50 per ton according to weight of packages, but that is the least part of it; the impossibility of getting up heavy enough machinery forms the most serious obstacle to the success of the mines, and this will disappear with the opening of the line; it will then also be possible to carry up a large traffic in coal for driving the machinery (a necessity becoming rapidly very urgent owing to the growing scarcity and expense of wood), or perhaps, and still better, crude petroleum for the same purpose, of which there is every reason to believe an unlimited supply exists only fifty miles to the westward and on the sea coast.

I shall not detain you longer. We have seen during the fifteen years an extraordinary race on the part of English, French, and Germans, for possessions on the continent of Africa; and though we might have had a larger share—indeed, but for the folly of our governments, Liberal and Conservative alike, twenty years ago, we might have had the whole of it—I say though we might have had a larger share, we have by no means come off badly, as without question, the richest portion has fallen to us; that obtained by the French, though much larger in area, is, as Lord Salisbury humorously said some years ago, what our farmers would call "light soil," and as for the German portion, it is probably valuable, and will be fairly well developed. Nevertheless, I make the statement that neither French nor Germans knew what they were after when this race began, and I venture further to prophesy that in another twenty-five years they will be heartily sick of it, and anxious to hand all over to us. It has already been made apparent that they had not counted the cost, and that they cannot successfully deal with the native races as England can. She has proved her powers, her fairness, kindness, common sense, all over the world, and, not least, in recent years, in Africa, and to-day we have on her coast, and in her far interior, men of refinement, as well as others who are blocks of rough-hewn British manhood, some of them, perhaps, not beautiful personages, for the founders of England's greatness have not usually been those who wear soft raiment and dwell in kings' houses, but men who have a work to do, and do it with no thought of self, and with a resolute courage which no danger can daunt and no difficulties turn aside.

The military and civil buildings of the rock of Gibraltar are now lighted by 3,000 electric lights.

the Passy tunnel this subject assumes a special importance, because of the number of trains that are to run over the line and each of which will be an element for further vitiating the air confined in the work. The first section of the tunnel, which has a length of 730 feet, will be ventilated by means of transverse galleries spaced 65 feet apart and connected with chimneys constructed in the sustaining wall of the Auteuil line.

As the two other sections of the tunnel are 1,213 and 1,070 feet in length, the question of a natural ventilation cannot be thought of. Upon these two parts there will be installed some pumps actuated mechanically, and each capable of furnishing 1,750 cubic feet of fresh air per second—a quantity fully sufficient to replace the air vitiated by the forty trains that will run through

(Continued from SUPPLEMENT, No. 1211, page 19422.)

CAST IRON.*

By Dr. R. MOLDENKE.

CAST iron is subject to two further troubles, which have a distinct bearing upon its general behavior. They are segregation and shrinkage. In the first, we meet a state of affairs perhaps a little more aggravated than in steel, for the rate of setting of heavy bodies of cast iron is slower, and consequently, more opportunity is given to the impurities to segregate and, therefore, impair the casting. Thus the total carbon in the center of a casting may occasionally be less than in the surface, while manganese, and especially phosphorus, may be segregated in very large quantities. In

the casting, is a much mooted question, evidence on both sides being in. It has appeared to the writer that the apparatus used by all those who have experimented in this line was too crude for the delicate observations which must necessarily be conducted. He, therefore, recommends the use of mirrors arranged to move with the cooling metal, and rays of light reflected from them upon bromide paper moving at a given rate of speed. This, if properly carried out, should give a sufficient enlargement, without any friction of moving parts, or absorption of minute movements in the mass of the apparatus.

A further difficulty to which many a failure to obtain sound castings may be laid is the presence of gas in the iron. This manifests itself by coming out at the moment the metal sets. If it can get away through the mould, well and good; if not, a smooth-walled aggravating hole, just under the skin, and often defying detection, is the result. The trouble may be laid to the handling of the furnace or cupola, the use of burnt material, and probably what is least suspected, the tendency of late years to produce pig irons too fast, with the resulting liability of oxidizing them slightly.

The peculiar shrinkages in iron are closely related to the heat conditions they have been subjected to, this bringing up the questions of fluidity, melting and casting temperatures. In general, we say that the hotter the melted iron, the greater its fluidity (and incidentally the shrinkage); that is to say, if an iron which melts at 2,200° F. is heated up to 2,400° before pouring, it will be more fluid than if only 2,250°, and consequently be likely to properly fill up very thin sections. Our common experience is that the higher the carbon, silicon, manganese, and especially phosphorus, the greater the fluidity of the iron. Sulphur acts the other way. Moreover, dissolved oxygen, which means burnt iron, takes all the life out of the melt, makes it stick in the ladle, and gives rise to misruns, dirty and spongy castings.

It is an open question still why white irons chill so rapidly, making it necessary to lose no time in pouring after tapping, while the gray irons can be transported for miles from blast furnace to converter, or held in ladles pending the ordinary delays incidental to daily work. True, the melting point of white iron is lower than the gray, but there should be about the same rate of cooling in both, unless—and this is quite likely—there are chemical reasons to hasten the congealing of the white varieties.

The one point which must not be forgotten here is this. After an iron is brought up to its melting point, it takes further heating to melt it, a situation parallel to making water from ice. Thus a white iron must be raised to about 2,100° F., and then requires one-tenth of the number of heat units consumed in doing this, in addition, to melt it. With the gray irons, which melt at only 150° F. higher, there are more heat units made latent, the total amount for them being about 10 per cent. higher. Aside from chemical conditions, and a possibility that the freezing point of each class of iron varies somewhat from the melting temperature (matters on which we have no information as yet), this circumstance may help to account for the remarkable length of time a gray iron may be kept fluid; for all this latent heat must be given out before it sets.

As to the melting point of cast iron, it was the good fortune of the writer to contribute a series of observations, on a wide range, of white and gray irons only last month, thus corroborating, by actual trial, the daily experience of observant foundrymen. The set of fifty-seven pig and cast irons, with but few exceptions, had no abnormally large variations from ordinary standards, but the range of silicon, from 0.14 up to 3.29 per cent. with their corresponding variations in combined and graphitic carbons, were admirably adapted to bring out the influence of the former to lower the melting point. The two extremes only are given herewith: a white iron which melted at 1,990° F. having 4.20 per cent. combined carbon, and a gray one going at 2,280° F., or 290° higher, contained only 0.13, the balance of the 3.56 per cent. total carbon being graphite. To properly determine the influence of phosphorus, manganese, and sulphur on the melting point, it would be well to take an iron which remains perfectly white at all casting temperatures, and add to it different proportions of these elements while it is in a melted state, casting each resulting mixture at once. In this way, all the carbon remaining combined, a good comparison would be obtainable.

In connection with the molecular structure of cast iron, its specific gravity is of some interest. The whiter the iron, the higher this will be, for not only does the space occupied by graphite in the gray irons decrease their density, but the very fact that they are gray, when cast under normal conditions, indicates that they may contain up to 3.25 per cent. of silicon. Thus the specific gravity of white iron is given as 7.6 and that of gray at 7.0. This difference has its influence in practice, for it is customary and convenient to simply weigh the pine pattern and multiply by 16 to get the weight of iron required to pour the casting. While this does very well for ordinary gray iron casting, the white varieties require a higher factor.

In a number of determinations made by the writer on the specific gravity of cast irons, the upper limit given above was extended a little, results as high as 7.8 being found where a white iron had been cast into chills. Gray irons which were chilled had the specific gravities raised 0.3 above their normal figure, thus showing the difference in density brought about by a change in carbons, from graphite to combined.

The purpose for which a casting is to be used naturally has, or should have, a deciding influence upon the kind of irons selected for making it. The days when anything went have passed, and the result has been a very discriminating specialization of the work. In a jobbing foundry, this may be taken care of to some extent, by suitably mixing the charges in the cupola, but in general, we find the best results obtained in shops arranged with their special ends kept constantly in view.

Here are a few varieties which show the flexibility of the general appellation, cast iron; heavy and light machinery castings, stove plate, light and heavy for air, ammonia, or steam; brake shoes; car wheels, which have gray centers and chilled rims; similarly chilled rolls; sand rolls, that is, rolls not chilled on their surface; gun metal, which is made in the reverberatory furnace, and embraces a variety of subdivisions; dy-

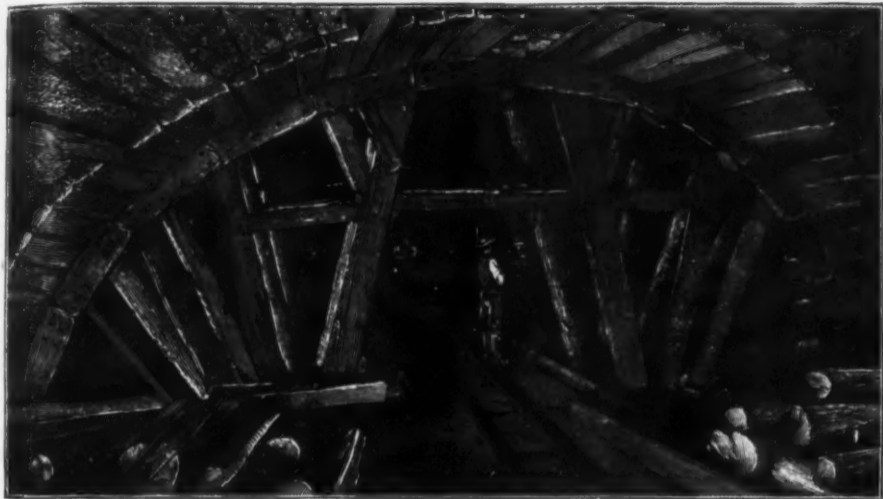


FIG. 5.—A TIMBERED GALLERY.

the tunnel every hour. Exhaust chimneys will be constructed at certain distances apart.

The work on the Passy tunnel, which was begun in September, 1897, will be finished before the month of March, 1900. It is a feat upon which the engineers who assumed the responsibility of it will have to be congratulated. These are M. Moise, engineer in chief of constructions of the Company of the West, and M. Widmer, assistant engineer in chief. The construction of the tunnel and of all the new parts of the line comprised between the Trocadero and the junction with the Seine line has been especially entrusted to M. Bonnet, government engineer connected with the Company of the West.

A last word as to the importance of the work. Although the chapter of expropriations amounts to but little, the cost of the 3.6 miles comprised between Courcelles and the Seine amounts to \$4,000,000, say a mean cost of \$1,111,111 per mile. It is evident, however, that the cost of the construction works will amount to more than this, since the work of

deed, the separating out of graphite in cooling is really a segregation.

As the fluid iron sets, it first expands and fills the mould, then, as it cools, it contracts, the net result being a slightly smaller volumetric space occupied in the mould. As a direct result from this contraction, the liquid iron is drawn to the setting surfaces, and more fluid metal must be fed in until the whole mass is solid. Should, for any reason, the supply of fluid metal be cut off, as, for instance, a thin section in setting cutting off access to a thicker one, there are bound to be unsound spots, called shrinkages, with consequent dangerous conditions. The very fact that they are seldom observed on the surface, unless, indeed, so bad that this dishes in, makes the testing of all castings calculated to resist the penetration of water or gases absolutely necessary.

These shrinkage spots are sometimes very beautiful, being lined with a glittering array of many colored pine tree crystals, grouped about in most fantastic figures. Necessarily, white irons, with their great contrac-

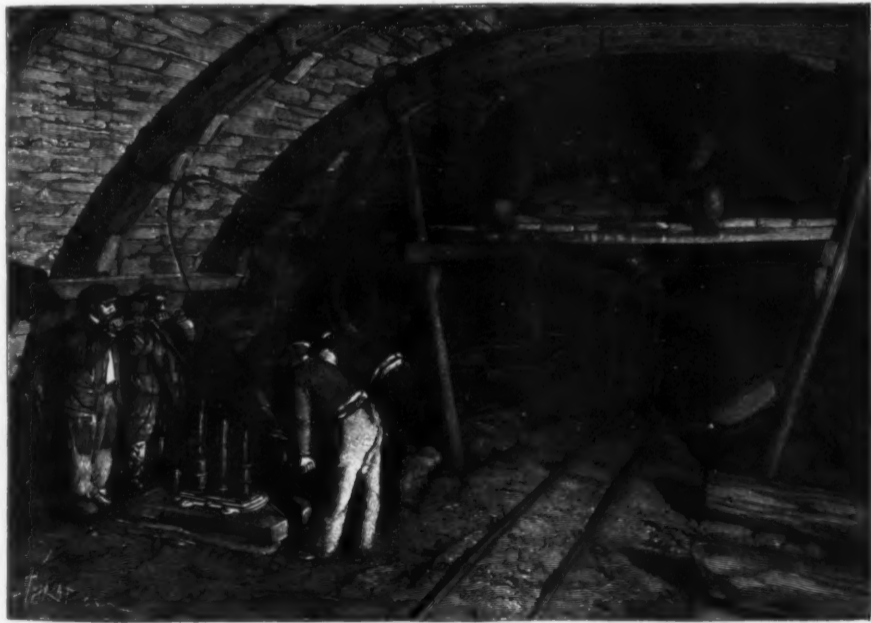


FIG. 6.—OPERATION OF GROUTING WITH CEMENT.

transformation as a whole between Courcelles and the Trocadero cannot be compared, as to importance, with the new constructions of the second section.

For the above particulars and the illustrations we are indebted to La Nature.

A bill has been introduced into the Wisconsin legislature providing that all railroad companies operating in the State shall be responsible for damages to every person and corporation whose property is injured or destroyed by fire communicated directly or indirectly by sparks from locomotives. The bill also contains the novel provision that the railroad company may have an insurable interest in the property along the route of its railroad and may procure insurance thereon in its own behalf for protecting itself against such damages.

tion and quick rate of setting, are especially subject to this difficulty, and special means must be resorted to to palliate, if not correct, the evil. The usual way is the application of a chill to the spots most likely to suffer.

We must, therefore, distinguish between the shrinkage in a casting which is internal, and its contraction, erroneously called shrinkage, also, which is external, and is allowed for in the pattern. There are some points in this matter which require further study. As a casting cools, the graphite already having separated out, there is a change in the carbon remaining combined, comparable to recalcination in steel. Whether this causes further marked disturbances in the size of

* Paper read at the November meeting of the Engineers' Society of Western Pennsylvania.

nano frame castings, in which magnetic properties are essential; ornamental castings, from radiators to imitation suits of armor, plaque, and even the exact reproduction of insects used as a pattern; pipe fittings; novelty work; hardware and agricultural machinery castings; pipes; plows, with their chilled points; ingot moulds; sash weights, the scavengers of the junk piles, etc.

All these materials are produced for the purpose indicated in the classification just outlined, by a proper adjustment of the silicon, phosphorus, manganese, and sulphur contents within the range indicated in the early part of this paper, and coupled with physical manipulations characteristic to foundry practice. Fortunately, where extreme ornamentation is desired, strength is no special object, and vice versa. There are, however, sometimes requirements specified which puzzle the foundryman not a little, for instance, where great strength is to be combined with ease in machining, amounting to practically an iron which is at the same time hard and soft. Naturally, in this instance, a sufficient amount of steel scrap is added to give strength by the reduction of the total carbon, and the silicon is kept up high enough to throw as much of the carbon present in the graphitic state as possible.

The strength of the iron is dependent upon its composition and the physical treatment received until a finished casting. Even afterward, the service conditions have a deteriorating effect, but little estimated; in fact, a value almost unknown as yet. Cast iron having for practical purposes no elastic limit, the actual breaking tests are better calculated to represent service conditions than is the case for all the other forms of iron. The strength of cast iron, as shown by physical tests, ranges between very wide limits. Not only will the different kinds of cast iron run far apart, but actually the same iron when cast into various sections shows a distressing lack of homogeneity, which makes comparisons the merest guess-work. What methods of testing to adopt, what test pieces to use, etc., is now occupying the attention of several national bodies of men interested in industrial progress, both here and abroad, and the outcome, it is hoped, will be of much benefit to the manufacturers and consumers of iron castings.

The tensile test is one very difficult to apply properly, but gives sufficiently high values to allow a differentiation, having a given size and shape of bar cast under as nearly the same conditions as possible. The tensile strength of cast iron may run from 14,000 up to 35,000 pounds per square inch, the former being found in soft but bulky castings and the latter in the highest grade of gun metal, strengthened with the addition of steel scrap. Here we see the effect of lowering the carbon in the casting; the strength, as a consequence, going up. High silicon lowers the strength; phosphorus, when not over 0.5 per cent., which is the safe foundry limit, rather stiffens the iron, makes it pull stronger, but leaves it brittle. Ordinarily, castings should run between 17,000 and 20,000 pounds per square inch tensile strength.

The modulus of elasticity of cast iron varies from 10,000,000 to 30,000,000, showing the utter lack of value of tests made on cast iron, unless all the conditions existing at the time are taken into consideration, and preferably all the outside influences affecting the results removed as much as possible. Again, a set of bars of the same cross section, but of regularly increasing length, when tested showed a regularly decreasing tensile strength, the last being actually one-half as strong as the first. Results of this kind shake one's faith in all tests on cast iron, but this very circumstance makes it all the more important to dive deeper into these mysteries and get more light and those rewards, always coming (usually to the other man, however), from patient investigation and study.

The transverse test of cast iron is the easiest to carry out, and with the same cross section, same distance between supports and the identical method of testing, the records are in some measure comparable. Yet it is idle to wade through elaborate tables giving the modulus of rupture of cast iron calculated to the square inch, when we know that the same iron, in bars of the same section, when tested with varying distances, between supports, gives hopelessly discordant values when the regulation formulae are applied. No wonder that the modulus of rupture per square inch, for cast iron thus calculated, varies from 10,000 to 65,000 pounds. In making transverse tests, the load applied to produce rupture, as well as the deflection, should be noted. Here, also, we have the effect of a moderate amount of phosphorus, showing itself in an increased strength and amount of deflection, but it will be noted that this is the case only with a very gradually applied and slowly increasing load, for the slightest shock means an instant break.

The crushing strength of cast iron is, so to say, its strongest point. It varies from 40,000 to 200,000 pounds per square inch. This test is seldom made, for if the iron is sufficiently strong to come up to all the other requirements, that of resistance to crushing is almost superfluous. Nevertheless, for certain classes of work, such as rolls and hammer dies, much could be learned in this way, especially when combined with heat conditions.

Impact tests on cast iron are almost unknown, but could be made with considerable profit, even though objections have been made on the ground that cast iron is never exposed to shock while in service. Once efficient machinery for this method of testing is provided, we shall hear more of it. We now have some vague ideas of the resistance of cast iron to shock from resilience calculations made of bending tests, but these results are empirical and need further extension and study.

A test for the hardness of cast iron would be a desirable addition to our list, and several ingenious methods have been brought out for this purpose. They will fail to be adopted generally, for we again strike the lack of homogeneity in cast iron which will leave the skin harder than the interior, and the cooler portion of the iron, while casting, softer than the hotter immediately at the gate. The methods of testing hardness, commercially, will, therefore, remain of local application, each shop requiring such a test getting up its own modification. Careful regulation of the mixtures and casting temperatures should go a great way to make this style of test only desirable in special cases.

There are other tests, such as punching and shear-

ing, for fluidity, contraction, chill, behavior under heat, etc. This much can be said, that the testing of cast iron is in so crude a state as yet that formulating elaborate specifications to cover anything but the most general points is often a positive injustice to the founder, and moreover, a retardation of progress toward an international agreement on standard methods of testing.

The writer has not dwelt much upon the effects of the various constituents of cast iron when present in large quantities, deeming this subject rather over-written of late. He begs the indulgence of his audience for any shortcomings in this hasty sketch of a widely diversified but highly interesting branch of the vast iron industry.

SHIPS' REFRIGERATING PLANTS—LINDE SYSTEM.

At the present time a very large addition is being made to the fleet of vessels carrying frozen meat from

upon a strong continuous bed, and this bed is fixed to a wrought steel box, forming a very stiff base, in which are placed the galvanized ammonia condenser coils. Each coil is in one length with the joints outside and easily get-at-able. All coils are tested to a pressure of 2,000 pounds per square inch, though the maximum working pressure is only about 200 pounds above the atmosphere.

The exhaust steam from the refrigerating and fan engines is condensed in an auxiliary condenser having a small independent compound engine mounted on it for driving the air pump, the whole being self-contained. The condenser also receives the exhaust steam from the electric light engines. The water circulating pump is independent.

The machines for Messrs. Turnbull & Martin's boats have been constructed and tested under the inspection of Lloyd's surveyors, and they are, we believe, the first refrigerating machines so surveyed. The rules under which Lloyd's will undertake such inspection and issue certificates have just recently been published.

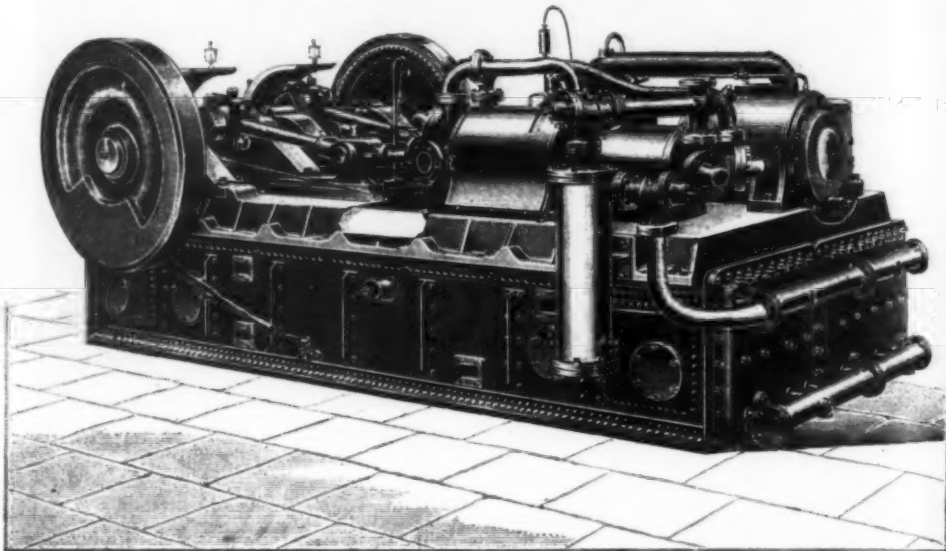


FIG. 1.—MARINE REFRIGERATOR.

Australia and New Zealand to this country. Messrs. Turnbull, Martin & Company are building three such vessels, and the New Zealand Shipping Company four. All these vessels, says Engineer, are being fitted with the most powerful modern refrigerating machinery by the Linde British Refrigeration Company, of 35 Queen Victoria Street, E. C. In each case provision is being made for carrying about 100,000 carcasses of frozen mutton, the foreholds and 'tween decks being insulated. The "Morayshire" and "Fifeshire," two of Messrs. Turnbull & Martin's boats, and the "Papanui," one of the New Zealand Shipping Company's boats, have already left on their first trip; the others are now in course of construction.

The system of refrigeration employed is that known as the "dry air circulation" system. There are no brine or other metal pipes in the insulated compartments, the cooling being entirely effected by means of pure, dry cold air, circulated by fans, so as to maintain

The work has also been carried out under the supervision of the Board of Trade, as the vessels carry passengers, and have a Board of Trade certificate. In addition to those mentioned above, the Linde British Refrigeration Company has already supplied the refrigerating machinery for seven almost equally large ships for Messrs. Turnbull, Martin & Company, as well as for three for the New Zealand Shipping Company, making seventeen large installations for these two companies alone.

Another illustration, Fig. 2, shows a Linde machine on the triplex system, with three compound compressors placed tandem to the steam cylinders, and driven direct by the tail piston-rods. The steam condenser is combined in the bed-plate; the air, circulating, and feed pumps being driven by means of a rocking shaft. This makes a very powerful, compact, and economical machine, and it is, of course, quite as well adapted for use on land as on board ship. As a fact, these ma-

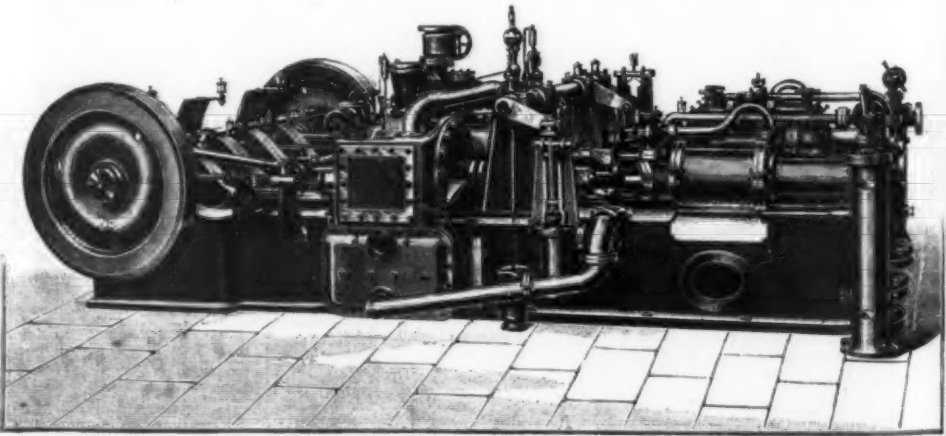


FIG. 2.—LINDE TRIPLEX REFRIGERATOR.

a very even temperature in the holds. These fans are driven by reversible triple-expansion high-speed engines, coupled direct to the spindles. The air is cooled by being passed over series of direct expansion coils placed in two insulated chambers, and each battery of coils is arranged to be worked either together or separately. By regulating the current of cold air different temperatures can be maintained in the various compartments, some being used for frozen meat, and others as desired, for dairy produce, fruit, etc. Each expansion coil is in one length with the joints outside of the chamber.

The refrigerating engines, which in each vessel are two in number, one being for space, are shown in Fig. 1. They consist of a patent compound Linde compressor, driven by a tandem compound steam engine placed alongside. The power is transmitted through a steel crank shaft, having the cranks set at the angle to give the best turning effect. The ammonia and steam cylinders and the main bearings are mounted

chines have been very largely used on land, several of the largest meat-freezing companies in Queensland and Victoria having adopted them for meat freezing and storage. The compressors being compound are specially good for countries where the temperature of the cooling water is very high. In several cases, both in Queensland and other places, Linde machines are actually in daily work, performing their guaranteed duty with cooling water as high as 102° Fah.

Altogether about 500 marine installations have been supplied by the Linde British Refrigeration Company, Limited, and these include machines for the British Admiralty, the Emperor of Germany, and the Prince of Monaco, as well as for most of the leading ship-owners.

A German investigator states that the fig was known to eastern people before the cereals, and that it was as important a fruit with these primitive tribes as the banana with those of South America.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Austrian View of United States Trade Competition.—Consul Baehr sends from Kehl, under date of January 23, 1899, a review of a lecture by a Viennese authority on political economy, Dr. Alexander Peez, on the subject, "America, Europe's most dangerous rival." Dr. Peez said, in part:

"Let us see how the American industries are prospering. We have first the sugar industry. It is not known yet how we will be able to make up for the loss of our sugar export to America. The United States has taken Cuba and is going to have the enormous quantity of sugar it needs supplied, if possible, by the home product and that grown in Cuba. The enlargement of its balance of trade is the fundamental principle of its commercial policy, and its government acts with great boldness. The Americans have already gained this much, that they export goods to Europe valued at \$1,200,000,000, and, on the other hand, import only for about \$600,000,000. This balance will be still more to their benefit when they are able to produce enough sugar in Cuba and Puerto Rico to supply their needs. This will probably take them about seven years. We shall have to make good use of this space of time."

"I wish also to make some remarks about the paper industry. We all know that this was one of our most flourishing industries. In former years—I regret that I have to speak of the past—some of the English newspapers were printed on Austrian paper. Now, the United States has wrested this trade from us, and is already supplying most of the papers used in England."

"We cannot give enough attention to the United States. Last spring, I was in Trieste and learned that there were in the ports of Constantinople, Fiume, Salonica, and Trieste about 30,000 quintals of American pig iron, of which the greatest part came from Arkansas and the Mississippi Valley. You may say that the iron falls there from the furnace right into the vessels, and is brought at very low freight rates into the Mediterranean Sea. At the same time, American iron makes its appearance, crude and manufactured, in the Elbe district in Bohemia."

"So far as machinery is concerned, we all know how the Americans are working. The very best of machinery, few workmen, but those well paid—that is their great system, and there is no doubt it is also the system of the future."

"Recently, the United States has also made great progress in the field of chemical science. Cotton oil, a product of cotton seed, was once a sticky brown-black paste; the Americans have found out how to purify this formerly nearly useless stuff, and the product is now being sold as cheap cooking oil, and finds ready buyers."

"Not long ago, I saw American shoe leather, fine, light, and smooth. It was made from skins of Indian goats, but finished in the United States; and all experiments made in England and Germany to produce a similar leather have failed."

"These are only a few instances. The industries of the European continent will, in many branches, have to count with American competition as well as with England."

Dr. Peez's lecture was followed by a discussion. In the course of the latter, the speaker dwelt upon the wonderful rapidity with which the Americans, in their war with Spain, increased and equipped their navy. In America, Dr. Peez said, the whole population consists of skilled men and shrewd merchants, who bring about the wonderful progress of the country. He repeated what he has been advocating for years—that the countries on the European continent would have to form a coalition to protect themselves against outside competition. This plan is also being discussed in some of the newspapers in Germany.

Sentiments similar to those expressed by Dr. Peez are frequently uttered by men in prominent public office, and published by the press of Austria-Hungary as well as of Germany.

Nizhni Novgorod as a Market.—I would suggest, says Consul Covert, of Lyons, the propriety and even the necessity of representation of our products at Nizhni Novgorod, Russia, on the occasion of the annual fair which is held there during the months of August and September. Within the last decade and a half this fair has assumed most important proportions. When I visited it, some twenty years ago, it was a general rendezvous for Russian and oriental traders, and but few Europeans and no Americans went there except as tourists. It is now an invaluable mart for the display of all kinds of manufactures, and especially for machinery. In a book entitled *La Russie Industrielle*, a French author who had spent some years in studying Russian markets advised his countrymen to send specimens of all their manufactures to the great Nizhni fair. He said that the Russians wanted to see samples of the machinery they needed. They will not buy from descriptions or engravings.

French manufacturers know this, and they will be adequately represented there at the coming fair. France already has a consular agent at that point, who is credited by the *Moniteur Officiel du Commerce*, of January 26, with having materially advanced French interests in that direction within a twelvemonth. The consular agent laid especial stress upon the possible market for woolen and cotton goods. He declared it a prime necessity to bring the manufacturer into direct contact with the buyer, and suggested the formation of a syndicate of manufacturers and dealers in woolens, cottons, silks, etc., the object of which would be the exportation of French goods into Russia.

The efforts of Russia toward industrial expansion, and the development of her immense mineral resources in the Ural Mountains and in the country opened by the Trans-Siberian Railroad, render this field of enterprise especially attractive to American manufacturers. Last year, a proclamation of the imperial government granted free trade in all articles entering Russia for the next ten years to be used in the Ural and Siberian mines. Specimens of the machinery included in this ukase will be freely exhibited at the Nizhni fair this coming summer. Everything entering into the work of building and equipping railroads or developing mines, as well as agricultural implements, will receive care-

ful attention of people who represent vast mineral and agricultural interests, now on the eve of development.

The market being opened for manufactures in the vast region referred to is more or less connected with the Russian advance in the northern portions of China. The Trans-Siberian Railroad, deflecting through Manchuria to Peking, Tientsin, and Pechili Gulf on the west, passing through Korea on the east, and sending a direct line to Talienwan and Port Arthur, will intersect the rich mining district of Shansi and establish connections with the Hoangho River. The mining districts of Manchuria are already being colonized by Russians, and Russian steamers now ply on the rivers of that region.

In possession of a Chinese frontier of 4,000 miles, Russia is making the best use of her opportunities to assimilate to her own people the inhabitants of all northern China. In offering free trade for machinery to be used in the mining industry, the Czar practically invites the great manufacturing states to aid him in the conquest of the populous East. The development of the mining interests of the Russian and Chinese empires, the building of railroads, and the navigation of rivers, with the opening of the tea, silk, and rice countries through which they run, not to speak of the new line of railway through Afghanistan to the frontier of India, are enterprises in the execution of which Russia needs the co-operation of the great industrial nations of the world.

All agricultural implements, fertilizers, etc., which may be exhibited at the Nizhni fair will be brought before every farmer in Russia through the medium of the "artels," or agricultural societies, which, under encouragement of the government, have rapidly multiplied in Russia during the last decade. They have representatives who are skilled, by scientific study and practical experience, in everything pertaining to farming, and whose business it is to look after and make recommendations upon stock raising, fertilizers, fodder, transportation, rates of freight, agricultural implements, etc. Anything of use on a farm will find appreciative consideration at the Nizhni fair.

The French consul at Nizhni lays especial stress upon the necessity of bringing the manufacturer in direct contact with the Russian purchaser.

American Orders for German Woolens.—Under date of January 16, 1899, Consul Brundage, of Aix la Chapelle, reports as follows:

Mr. Carl Delius, the largest exporter of woolen cloth from this consular district to the United States, informed me last week that he had received sufficient orders from the United States to keep his mills in operation with full time for the next four months; in fact, he was compelled to refuse orders from Belgium and England. The other manufacturers are very cheerful in anticipation of many orders, per advice by their agents in New York. It occurred to me that these facts might be of some interest as general information. Evidently our present tariff does not exclude manufactured woolen products from America, for this district sent (in last quarter) over \$100,000 worth of woolen cloth.

British vs. American Consular Reports.—On January 11, 1899, Consul Marshal Halstead, of Birmingham, transmitted the following editorial from *The Mechanical Engineer*, London, January 7:

Our manufacturers have long complained of the inadequate service rendered to the commercial interests of the country by its consular representatives abroad, and latterly, efforts have been made by the Foreign Office to remove some of these reproaches; but the reports sent by British consuls for the guidance of manufacturers at home are often greatly lacking in the technical information which the manufacturers here would most prize. One set sermon seems to underlie the basis of the majority of these reports, which is the prejudice of British manufacturers in adhering to their own ideas of design, the lack of representatives abroad familiar with the languages and customs of foreign clients, and the refusal of English manufacturers to fall in with the metric system of weights and measures. While it may be readily admitted that there is force in some of these criticisms, one cannot but feel that the reiteration of these points is made to cover a considerable amount of indifference on the part of consuls, respecting the real technical needs of manufacturers and makers at home. The reports of American representatives to their government are often in striking contrast to those of our own, and as an illustration of the kind of report which our manufacturers would prize, we should like to draw the attention of our authorities to the extracts from an advance report by Mr. Halstead, the American consul at Birmingham, given on another page, in which the wants of English customers of American tools are summarized for the benefit of manufacturers in the States. The opinion is just the kind which tool makers across the Atlantic will appreciate, and which will help them to maintain their superiority in those sections of our markets which they have gained by their ingenuity and adaptability.

Varnish, Rope, and Canvas in Paraguay.—Probably, most of the varnish used here comes from the United States, but it does not come directly, appearing to go first either to England or Continental Europe, there to be reshipped to South America. The wholesale and retail price is \$1.35 gold per gallon. There is but little furniture in Paraguay that is not varnished.

It is to be hoped that United States varnish dealers will endeavor to establish direct communication with business houses in Asuncion, thus preserving the character of our goods as well as enhancing their reputation. I give below, says Consul Ruffin, of Asuncion, a few names of firms to whom dealers could write.

Manila rope also has a large sale here, coming indirectly from the United States. The class principally used (about the size of the middle finger) is sold for 13 or 15 cents gold per pound.

Twine is another United States article whose identity is lost, owing to its passing through foreign hands. Fishing is carried on very extensively. Twine is sold for 35 to 40 cents gold per pound; the cotton twine brings from 30 to 35 cents gold per pound; fishing lines, 30 cents gold per pound.

I would also call the attention of the American manufacturers to the favor in which their canvas is held. It is used for sails on the many small boats, canoes, etc.,

plying on the rivers and lakes; also for the large sailing vessels, and for domestic purposes, as coats for sleeping, etc. The poor people use the cot instead of the bed almost exclusively, the cost being about \$1.50 gold. Many of the rich in this warm country also use coats, as they are cooler.

The country from which this canvas chiefly comes is the United States, and the principal mark is "Extra Duck," sold here for \$1.00, paper (about 25 cents gold), per yard. This does not come directly from the United States, being handled, like the others, by foreign houses.

I again appeal to our manufacturers to establish a showroom for American goods, and also to deal direct with the Asuncion firms. The following persons would handle our goods: Enrique Plate, commercial agent and commission merchant; Christian Heiseke, Ruiz y Jorba, Francisco Angulo y Cia, Gaona y Urrutia, Gomez y Cia, Trabucatti y Cia, Crobats y Rodi, Miguel Bajae. With the exception of Enrique Plate, who can be communicated with in English, I would recommend that all correspondence with the above firms be in Spanish, thus securing ready attention and replies.

Commercial Conditions in Dublin.—In a letter to the National Association of Manufacturers, dated October 23, 1898, Consul Wilbour, of Dublin, says:

"All goods shipped from Dublin to the United States go via Liverpool or Glasgow, none being shipped direct. Ordinary bills of lading are in use, virtually the same as those in the United States. For freight rates between Dublin and other ports, special terms are given, based on quantity, class of goods, etc. No schedules are published, but the rates may be learned on application to the steamship companies of New York, Baltimore, etc. Port regulations are uniform throughout the United Kingdom, the charges being 21 cents per ton for vessels from over sea and 13 cents per ton for coasters. There are the usual charges for stevedores, labor, etc."

"There is no reason why trade between the United States and Ireland should not be largely increased. The following articles are imported in large quantities from Germany, Holland, and Belgium: Wood ware, paper, starch, iron nails and other hardware, brushes, glassware, bottles, leather, oleomargarine, and condensed milk. Over 1,000,000 tons of coal were imported in 1897. Bituminous coal is used exclusively, retailing from \$4.50 to \$5.50 per ton. The best of our bituminous coal could be landed here and sold at a handsome profit at a considerably less price than that quoted above. There is a prejudice against American coal, which would have to be overcome."

Timber comes largely from Norway, with considerable shipments from Canada and the United States. The trade in American slates is growing, and could be largely increased with proper facilities for shipping."

English Demand for Chaff Cutters and Threshing Machines.—The following, dated January 31, 1899, has been received from Consul Halstead, of Birmingham:

"I have to-day received the following inquiry: 'We should be greatly obliged if you would kindly give us the names of a few American manufacturers of chaff cutters and threshing machines for hand and horse power, as we have a very good market for same.' I will be pleased to put the first firms responding into communication with the concern making the request."

Demand for Wire and Wire Nails in England.—Consul Marshal Halstead writes from Birmingham, February 4, 1899: "This morning I have received an inquiry from Wales for the names of American nut and bolt manufacturers, and also wire nail makers. The bolt and nut names I have already supplied, but for wire nail makers I must wait the response from the United States, which should follow the publication of this communication in the Consular Reports. I have also a request for the names of manufacturers producing wire for making wire nails."

American Railway Cars in Australia.—Under date of January 14, 1899, Consul Goding writes from Newcastle: "I have arranged for the purchase from American manufacturers of a railway combination car, to cost, approximately, £1,000 (\$4,800). There is a general awakening to the fact that what the people here want can be furnished by American manufacturers at a much less cost than by other countries. I am doing what I can to encourage this idea, and my efforts, I think, will be followed by good results."

Government Aid to the Export Trade of Germany.—The German government fully appreciates the value of a good, permanent consular service. The increasing support lent by the imperial government to commercial enterprise finds expression in the estimates and in the growing demands for the consular service. Additional secretaries are to be appointed to the legations at Mexico, Peking, and to the embassy at Washington. To the embassy at St. Petersburg, experts in agriculture and forestry are to be appointed, in view of the importance of the Siberian railway. New consulates are to be established at Bahia, Santa Catarina, Curitiba, Hankan, São Paulo, and Prague. Sixty thousand marks (\$14,000) are demanded for the sending of commercial experts to the United States, South America, and Turkey. These items, insignificant as they may seem from a financial point of view, prove conclusively with what keen attention the German foreign office is watching and supporting German commerce abroad. Without neglecting agriculture at home, the German government is making commercial interests more and more the basis of its foreign policy. On the continent of Europe, perhaps, that policy, to a certain extent, is influenced by Germany's territorial relations; but, apart from this consideration, German export trade forms the center of gravity of almost every political transaction, and every encouragement is being given to it by the Imperial German government.—John F. Winter, Consul at Annaberg.

Demand for American Mantels in Europe.—Consul Halstead writes from Birmingham, November 23, 1898:

A firm of merchants in Birmingham wishes to be put in communication with manufacturers making wooden mantels and overmantels, which technical term means a looking glass, shelves, and recesses combined in the mantel frame. The firm would prefer to buy these mantels through a London house, because they do not wish to stock them.

M. DE BAYE'S MISSION TO THE CAUCASUS.

BARON DE BAYE, well known to fame by his travels in Siberia, has recently accomplished a brilliant expedition to the Caucasus, to that as yet little known region which separates the Black Sea from the Caspian and extends to the frontiers of Persia. Commissioned by the Minister of Public Instruction to go to study the archæ-

has now more than 35,000. In 1888 it exported 46,000 tons of merchandise, while in 1896 it exported 767,000. Such progress as this is ordinarily seen only in the United States. Yet Novorossysk is a European city, and a Russian one at that.

It was wheat that made the fortune of this place. The Vladikavkase Railway Company, having seen what advantages were possessed by this port, which is of great depth and never freezes over in winter, opened, in 1888,



THE NEW CITY OF NOVOROSSYSK.

ology and ethnography of the Caucasus, the intrepid explorer occupied four months in traveling over this country in every direction and in gathering an ample store of information of every kind, of which he is going to give us the benefit.

Like a practical minded man, Baron de Baye did not occupy himself exclusively with the scientific mission that he had to accomplish, for his attention was directed also to the industrial and commercial organization of regions that are still behind the age, but which have become civilized during the last few years, and have developed economically in an astonishing manner. We shall follow him upon this second ground solely. The explorer began his journey at Northern Caucasus and the city of Novorossysk. By its wonderfully rapid development this place recalls certain of the cities of North America. This port of the North Sea, an ancient Turkish village, had but 2,000 inhabitants in 1885, but

the Tikharetskaia-Novorossysk branch in order to carry thither the wheat of Kouban and Stavropol. So, as happens in the New World, the railway created the city.

The principal place of the newly created government of the Black Sea, its territory was detached from the province of Kouban, because of the importance that this city is destined to assume. The French vice consul at Batoum has been transferred thither.

The large structure seen in the middle ground of one of our engravings is the elevator. The building is without elegance, but is imposing, and towers above the surrounding roofs. Just as cities of former times have been overshadowed by their cathedrals so Novorossysk has grown up under the shadow of its elevator.

This elevator, which is an immense storehouse for cereals, is the work of the railway. In a report published in the *Moniteur Officiel du Commerce*, M. Le-

feuvre Meaulle, the French consul, asserts that it embodies more improvements and is perhaps larger than the elevators of Chicago. It is capable of holding one hundred and ten million pounds of wheat.

The grain reaches the elevator through trains of thirty-two cars, which are open and allow it to fall into thirty-two hoppers. Thence it is carried by a system of gutta-percha belts and buckets to the ninth story of the edifice, situated at a height of more than a hundred feet. Here the buckets empty it into another series of hoppers placed over scales which weigh it automatically before it descends to the seventh story. There it runs to unoccupied bins, in order to await shipment. In addition to being weighed, the grain may, at the request of the purchaser, be screened and cleaned by a mechanical process.

The grain is removed from the storehouse with the same ease. It is taken up by a system of belts and buckets, and, having traveled a distance of more than half a mile through a gallery ten feet in width, it reaches the jetties belonging to the railway company, where it is emptied into the hold of the steamers through huge iron plate conduits.

A new railway line, the construction of which will be begun this year, will, in a near future, connect Novorossysk with the basin of the Volga, with the Trans-Siberian and with Central Asia through the Orenburg road.

Novorossysk comprises two distinct wards, viz., the old city and the new one, which are separated by marshes that are in the process of being drained. The old city has preserved the mask of its nationality, while the new one is almost European, with buildings that have a modern and western character. The houses are generally of stone and brick and have a very pleasing aspect.

A very important German Portland cement manufactory is situated near the new city of Novorossysk. It is on the tide of prosperity and is doing a most excellent business, although for several years it has had a competitor, in fact, there has been founded to the south of the city, at Guelindjik, upon the shore of the Black Sea, a Franco-Russian Portland cement works under the superintendency of M. Andrieux.

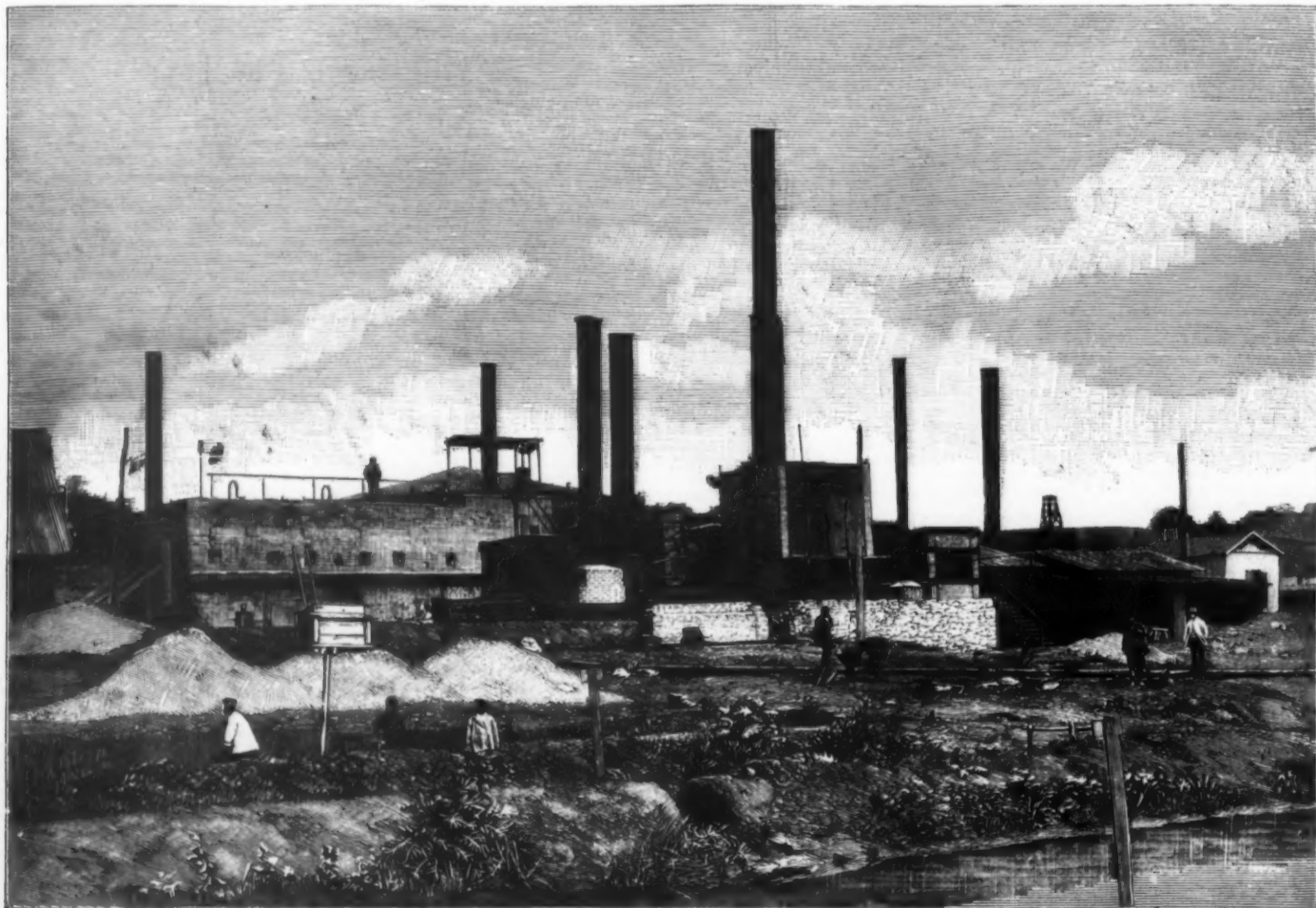
At the time that Baron de Baye reached Novorossysk, a French ship had just been received and feted. The vessel had been the object of a reception full of enthusiasm, for the friendly feeling of the population toward the French is shown every time that a pretext is furnished.

The Russian Standard Company, which constructed the new city, is especially occupied with the exploitation of petroleum, one of the principal industries of the country. In the government of Kouban, upon the line of the railway, between Novorossysk and Ekaterinodar, near the station of Isskaia, it owns a large concession of land whence it obtains petroleum in abundance. We reproduce two photographs that give an idea of this exploitation. The first represents the refinery and the second the wells surmounted by the derricks.

The wells show signs of exhaustion, and so the company has begun borings at a point nearer the Caspian Sea, in the vicinity of Grozny, which is quite a large city, with a population of 14,000 inhabitants, composed of Russians, Armenians, Georgians, and Jews.

The exploitation of petroleum is not the only industry of the country, for tobacco is cultivated and sulphur is mined there.

As for tobacco, our illustrations show how the



NAPHTHA REFINERY AT ISSKAIA.

Inhabitants proceed in preparing and drying it. Stretched over or suspended from frames, and protected from the wind by a sort of screen made of branches, the plant dries under the best of conditions. Much sulphur is found in the district of Andl. The only mines worked are those in the vicinity of Aoul Tchirkat. These are the Khiont mines. Baron de Baye brought home several specimens of the article, which will be exhibited next May at the Guimet Mu-

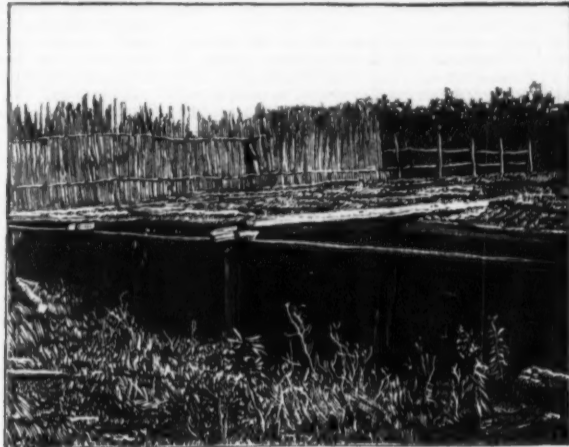
The Mahometans have also their place of devotion, and, at Karabondack, have a mosque from the tall minaret of which the priest announces the evening prayer as the sun goes down behind the mountains in the west.

The favored ones who have the privilege of making so interesting voyages have no occasion to regret their trouble when they can come back to make us participants in their discoveries and their feelings. It is

suite informed her majesty that the engineman of her train was a prince. The Empress related the incident to the Czar, who immediately sent for the prince and became interested in him. Prince Hilkoof gradually climbed the various rounds of the business, and, as he was very intelligent, the Emperor one day intrusted him with the full administration of the railways on which he had made his debut by the most modest functions.



PREPARATION OF TOBACCO.



DRYING TOBACCO.

seem along with all the ethnographical, anthropological, and archaeological collections made during his mission. The Khiont mines were conceded to Prince Eristoff, who exploited them himself in the first place, and afterward leased them to a French company, which did not keep them.

In 1896, 958,320 pounds were extracted, and in 1897, 1,800,000, from which 414,000 pounds of pure sulphur were obtained.

In Daghestan there are many aouls (villages), near which similar quantities of the mineral might be extracted, but roads are wanting; and this is a fact to be regretted, for the reason that sulphur is indispensable in the refining of naphtha. Now, to speak merely of Backoo, there are used in this locality 36,000,000 pounds of sulphur a year, and every bit of it is imported from Sicily.

The monastery of Etchmadzin is situated near Erivan, in Russian Armenia. This country is occupied by the imperial troops. The English covet it and are frequently encountered in these regions.

The Christian pilgrimage from Allaverdy to Kakhetie is of a most important character. Fifteen thousand individuals belonging to the most diverse races and religions travel thither at a fixed epoch. It furnishes an opportunity for an observer to make some curious ethnographical studies. The Kevsours are particularly curious to observe. These inhabitants of the mountains have preserved their types and habits with much purity. This is especially due to the fact that they are shut in by snow for three-quarters of the year, and hence are unable to have any continuous dealings with the populations of the plains. Upon their breast they wear a cross, from whence it has long been supposed that they are of very ancient origin. They have been regarded as descendants of the crusaders, who became fixed in these regions upon their return from Palestine, and who have preserved the sign that distinguished them. It appears, however, that this theory must be abandoned. This is Baron de Baye's opinion, at least, and his authority in such matters is too weighty to allow us to attempt to controvert it.

The young woman shown in one of the engravings in national costume was photographed by Baron de Baye during the pilgrimage. She was a Georgian of rank.

well to say that the Russian government received our mission with great cordiality and greatly facilitated its work. Prince Hilkoof, Minister of Roads and Communications, displayed great kindness also. Apropos of Prince Hilkoof, let us relate an anecdote that proves that merit counts in Russia as everywhere else. The



YOUNG GEORGIAN WOMAN OF RANK.

prince belonged to a very poor family, served an apprenticeship as a mechanic, and started for America to practice his trade. After many years he returned to Russia, went into railroading and became an engineman. One day, while he was running the locomotive of the imperial train in which the present Dowager Empress was a passenger, one of the persons of the

For the above particulars and the engravings we are indebted to Le Monde Illustré.

WHAT THE VERY POOR EAT—DIETARIES OF SLUMS IN AMERICAN CITIES.

EXPERTS of the Department of Agriculture have been making a special study of the foods eaten by foreign-born people in American cities. Their attention has been devoted chiefly to the very poor, because with them the problem of food supply is one of acute and even overwhelming importance. The well-to-do citizen regards the supplies for his table as a mere incidental, the bulk of his income being expended in other ways, and largely for luxuries. But with the poor it is quite otherwise; mere maintenance for their bodies is the chief anxiety, and absorbs the bulk of the money product of the family.

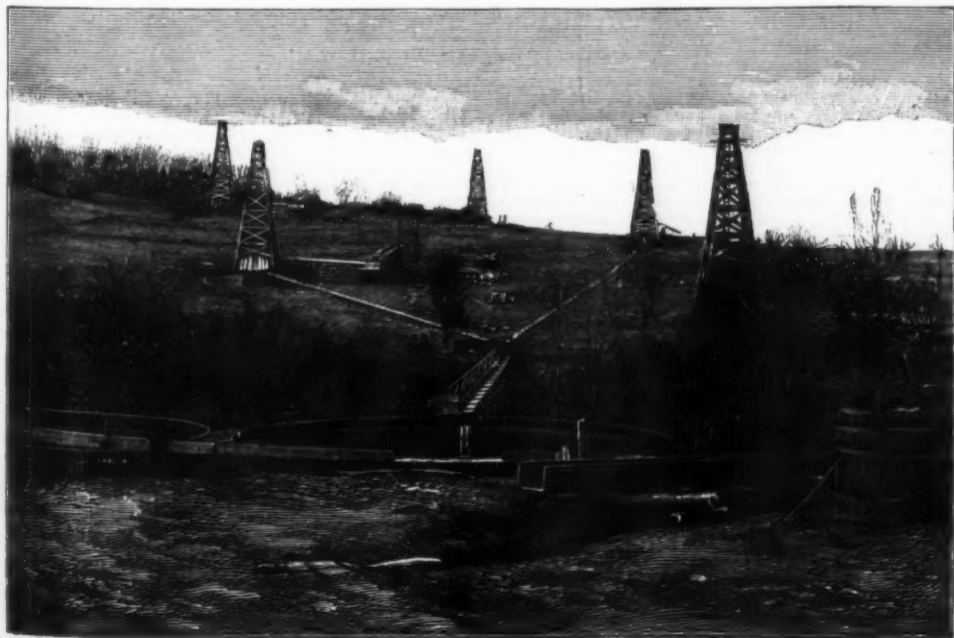
The experts made their studies in districts of various cities where people of many nationalities have their homes. As might be imagined, they encountered many difficulties. Not a few of these aliens, settled on American soil, were suspicious of the motives of the persons who desired to subject them to a quasi-microscopic observation in regard to their eating and drinking. Naturally they could not understand it, and imagined that the agents of the Department of Agriculture were spies set to watch their private affairs. In several instances it was necessary to pay them for the privilege of permitting the dietary studies to be made.

Now, the method of the dietary study is simple enough. When a family is under this kind of observation, two visits are made to it daily, and on each occasion all food materials bought since the previous call are carefully weighed. The family is instructed to weigh portions of flour and sugar, if considerable quantities of these are on hand, and to use only from the weighed portions. Of course there are chances of error. Things run out just before meal time, and the smallest girl is dispatched with orders to purchase five cents' worth of tea, three cents' worth of crackers or what not. But in most instances pretty definite data were secured.

The experts had their own figures as to the per cent. of muscle-forming substance in a pound of beans, and as to how much fuel a pound of eggs would furnish; the same, too, with all sorts of everyday foods. But they came across quite a number of articles entering into the dietaries of the foreign-born people which were new to them, and of these they were obliged to make special analyses. Also, they came across various inferior articles in common use, such as low grade and cheap flour, which did not correspond in food value to the high grade articles, and here again special analyses were requisite. In none of the studies was it found practicable to make an accurate reckoning of the kitchen waste.

The method adopted for reckoning the food values of various articles purchased in the markets was very pretty and simple. A turnip, for example, of a given weight contains a certain amount of substance that goes to make muscle and blood. Also, it contains a certain quantity of another kind of substance which furnishes fuel for running the body machine. A human being requires fuel as much as a locomotive does, else he would run down and come to a stop. Fat is a fuel; sugar and starch are fuels. You eat half a pound of sugar and it contributes nothing to make muscle and blood in your body, but to your body it is just what coal is to the locomotive. It is the same way with starch or with the fat of meats. If you want blood or muscle, you must eat the foods which supply that sort of material, such as lean meat or peas and beans. Most foods contain both fuel stuff and muscle stuff, but the proportions vary. Accordingly, it is of the utmost importance to know how much of each is contained in each kind of food.

Extraordinary difficulty was encountered in obtaining the consent of Italians for dietary studies in their homes. They did not see why the government should wish to inquire as to their private domestic arrangements; to weigh the flour and meat which they ate, and to write a report on the subject. There must be something unpleasant behind it, and, anyway, it was impertinent. Nevertheless, the essential facts were secured by careful investigation. It appears that the chief article of food of the Italians in American cities



NAPHTHA WELLS.

are wheat flour (or bread), macaroni, and noodles. Potatoes, beans, and peas also furnish an economical source of nutriment. People of this nationality, after acquiring residence in this country, cling to their native dietary habits with extraordinary persistence. They consume a great deal of macaroni, which, fortunately for them, is made in the United States. The same is not the case, however, with Italian oil, wine, and cheese, which even the poorest families utilize daily, though they have to be imported and are proportionately expensive. Such articles are comparatively cheap in Italy, and so this transplanted population has become accustomed to their use.

One of the most interesting branches of the investigation described had relation to the Russian Jews. It appears that these Jews—at all events those of them who are orthodox—are extremely careful to adapt their diet to the requirements of ecclesiastical law, and the preparation of their food is equally governed by religious considerations. Of course the Jews in general have their rules about these matters, which are apt to be carefully observed, but among them there are no people more strict in this regard than the Russians. So far as vegetables and fruits are concerned, there is no prohibition against anything, but when it comes to meats very elaborate regulations must be observed. The animals must be slaughtered in a particular manner, all of the blood being removed from the body by severing arteries in the neck. In order to get rid of the last of the blood, the meat is usually soaked in water for several hours after being bought, some of the nutritious constituents being thereby lost.

The orthodox Jews buy their chickens alive and kill and dress them according to their own customs. They seem to eat comparatively little fat. In general, among the families studied, the orthodox Jews were in better health than the unorthodox Jews, who are restricted by no religious rules to a prescribed manner of living. In most of the Jewish families studied the condition of the rooms was, to say the least, untidy; potato parings, bones, and all other food-refuse were thrown upon the floor and swept up once a day. Such families always clean the house thoroughly once a year—I. e., at the time of the Passover. A less thorough cleaning is usual whenever a birthday in the family is celebrated.

There is no question of the fact that even the poorest people, though they waste very much less than the well-to-do, actually throw away a great deal that might be saved, simply because of ignorance of a few matters easily understood. It cannot be expected of them that they should know what per cent. of a pound of beefsteak goes to make blood and muscle, and how much of it is fuel for the running of the body-machine. They go to the market, and they buy what seems most palatable at the smallest price. This is very well as far as it goes, but some of the most palatable articles of diet—as fruits, for example—are the least sustaining. Even this remark, however, is not to be made without reservation, inasmuch as fruits are desirable for health, and a few of them, like the banana, are very nutritious indeed.

The experts have a curious way of reckoning the fuel-power in a pound of food. They estimate it in terms of "calories." This is simple enough, when it is understood, inasmuch as a calory represents a certain amount of "go" for the machine, like a turn of the driving-wheel of a locomotive. So, when it is said that a man requires about 3,000 calories to run him for twenty-four hours, it is easily comprehended what is meant. The trouble with many people, and particularly very poor people, is that they select foods which contain too little fuel-stuff in proportion to the muscle-forming substance, or vice versa.

A special study was made of Bohemian families. It was ascertained that these families purchased their food at Bohemian markets, but that the character of the supplies was not peculiar. It is a custom at Bohemian markets, however, to give a piece of liver and a bone with each piece of beef sold—an item interesting to frugal housewives. Chopped beef and pork are common articles of food among the imported Bohemians. The butcher has a platter of chopped beef on one side of him and a platter of chopped pork on the other, and he mixes them to suit the individual customer. The milk dealers in these markets also sell skimmed milk and cream separately. Among the Bohemians the term "milk" is applied exclusively to skimmed milk. They usually buy more or less cream, which is added to the milk, the mixture being called "milk and cream." The amount of cream added depends upon the purse of the purchaser.

The dietaries of quite a number of Bohemian families were accurately studied, and it was found that the expenditure for food per individual averaged eleven cents a day. This result indicated a very wise and prudent expenditure for table purposes. It was found that in nearly all cases the Bohemians obtained their food at a lower cost than did the people of any other nationality studied. This was particularly noticeable in the animal foods, for which the price paid per pound was frequently not more than two-thirds that paid by other families with equal incomes.

A special investigation was made with the purpose of ascertaining the modifications in diet attributable to residence in this country. For the accomplishment of this object, families were selected which had been in the United States for different lengths of time. From the data obtained it appeared that a gradual change in diet followed removal of residence by Bohemians to the United States, and it is supposed that similar observations would apply to immigrants of other nationalities. When the Bohemians first arrive, their diet naturally tends to conform itself to that to which they have been accustomed. They consume large amounts of rye flour, pork in considerable quantity, and comparatively little beef, with hardly any wheat or corn, and no variety of green vegetables and fruits worth mentioning. As they become more accustomed to the conditions existing here, they consume less pork and more beef, more wheat flour and wheat bread and less rye flour, and a greater variety of vegetables and fruits. The second generation, native-born, adopts the American diet pure and simple.

Special attention was devoted to French-Canadians, but the only notable fact deduced seems to have been that these people are remarkably fond of pie. They spend nearly as much on pastry as they do on bread—say pastry and cake, which come in the same category.

Nobody can deny that pastry and cake are good foods, but at a given price they are only one-fourth as sustaining as bread. Recently there was a good deal of discussion as to the nutritive quality of wheat bread. It was asserted that the article had been greatly overestimated, and many things were much more digestible and sustaining than the so-called "staff of life." However, the fact back of all this nonsense is that bread, whether made of wheat, corn or rye, is an extremely valuable dietary substance. It is a fuel food typically, containing a great deal of starch, but, in addition, it has about twelve per cent. of the substance which makes muscle and blood. No reasonable person would suggest that a man ought to be able to live and be healthy on bread alone, but it furnishes none the less a most admirable basis of diet.

Naturally, the poor are limited in their choice of foods. It appears to be recognized by them pretty generally that wheat flour in bread, or otherwise prepared, furnishes the largest return for money expended. Strange it seems to be obliged to state that, through the practical working of domestic necessity, the poor of the great cities have arrived at conclusions not far different from those obtained by the scientific experts. In other words, they have ascertained by trial the foods from which they can get the largest amount of nourishment and the utmost of working power. The experts confess that they can hardly suggest any way in which, in certain cases, the money available could be expended more profitably for nutrients. Given a possible expenditure of \$6 per week for food, there are poor families, and many of them, which get as much out of that sum in the shape of nutritive supplies as the best scientific knowledge could furnish.

a man. A child six to nine years old requires one-half the food of a man. A child three to five years old requires four-tenths the food of a man, and a child under two years old requires three-tenths the food of a man.—Rene Bache, in *The Sanitarium*.

PASSIFLORA "MARGARET WILSON."

THE passion flowers form, in many respects, a remarkable group of flowering plants. The structure of the flower attracted notice long ago, and suggested the adoption of a symbolical designation for the order. Many of the very numerous species, all exotic, have found their way into cultivation. The most familiar one is the widely-grown *Passiflora corulea*, a south Brazilian plant, with constitution so hardy as to enable it to withstand, with a little shelter, the winters of the south of England, and the winters of Scotland also when they are open. The white variety of this species, *Constance Elliott*, differs from the type in lacking the "corulean" colors of the radiating coronal filaments, the petals and sepals being almost the same in both. The leaves of *P. corulea* are commonly five-lobed, the branches sub-terete, obscurely angled, and the stipules large and aristate. The flowers are three to three and one-half inches in diameter, the perianth flat or recurved, and the coronal rays straight. The odor is faint and unpleasant.

In another section of the genus the species have leaves simple and ovate, branches quadrangular and winged, and stipules small and tapering. *P. alata* and *P. quadrangularis* are well-known warm greenhouse examples of this section.



PASSIFLORA "MARGARET WILSON"—COLOR OF PERIANTH LILAC-ROSE.

(From a drawing by the raiser, Dr. J. H. Wilson.)

In general, the experts say, the cost of a diet may be diminished by consuming less fruit, less expensive cuts of meat, and fewer vegetables than are ordinarily eaten. Fruits add comparatively little to the food value of a diet, although they are useful for other reasons. The cheaper cuts of meat are as nutritious as the more costly cuts, and may be prepared in such a way as to be very palatable. Vegetable foods are essential to a well-regulated diet. Wheat flour in the form of bread or macaroni is one of the most nutritious, and at the same time one of the cheapest foods. Most vegetables do not contain much food-material, because their bulk is largely water; but they stimulate appetite and furnish bulk.

The problem of proper sustenance of the poor in large cities is continually assuming greater proportions. In many cases the income of a family is so small that the greater part of it must be expended on the necessary food. Not infrequently, through ignorance of the nutritive value of different foods, unwise selection, and improper cooking and serving, the actual value of the food for nourishment is much less than might have been obtained for the same money expenditure. Obviously, the power of a man to do work depends upon his nutrition; a well-fed man has strength of muscle and of brain, while a poorly nourished man has not. It is a very interesting matter in this connection to mention that, according to the conclusions of the government experts, a woman requires only four-fifths of the food of a man, the work performed by both being equal. A boy from fourteen to sixteen years old requires four-fifths the food of a man. A girl of the same age requires seven-tenths the food of a man. A child ten to thirteen years old requires six-tenths the food of

The peculiar traits of certain species evidenced by their reluctance to set seed with their own pollen, and yet be readily susceptible to cross fertilization, have engaged the attention of skilled observers. Among the numerous hybrids secured, there is one of special interest in the present connection, viz., *P. Buonapartea*. This beautiful passion flower is commonly understood to be a hybrid between the above named quadrangular stemmed species. The perianth is five inches in diameter, fleshy, deep red, and never flattened out. The long, wavy, coronal rays form a deep basket, barred and dotted with "red, white and blue," inclosing the conspicuous reproductive organs. To add to its attractiveness, the odor is powerful and pleasant.

The new hybrid shown in the illustration, says *The Gardeners' Chronicle*, is from *P. Buonapartea*, fertilized by *P. corulea*. One seed only germinated out of many taken from a fine fruit. While bearing resemblance to *P. Imperatrice Eugénie* and others derived by crossing *P. alata* or *P. quadrangularis* with *P. corulea*, it is quite distinct from and in many features bears very favorable comparison with these. Its fine lilac-rose color, its pleasant and not too penetrating perfume, its shapely leaves, and very robust and floriferous habit, render it a desirable addition to the list of indoor climbers.

It possesses many characters of botanical interest, its hybrid nature being very manifest in every structural, even microscopical detail. It may suffice at present to mention one interesting feature, in which ocular demonstration is afforded of a remarkably precise solution of an arithmetical problem. The leaves of the one parent have, so to speak, one lobe, the other five lobes, and the hybrid three.

ENGINEERING NOTES.

Tests of bicycle tires, recently made by Prof. R. C. Carpenter, of Cornell University, show that, other things being equal, the larger the tire the easier runs the wheel. A marked difference in ease of running is found between a $1\frac{1}{2}$ -inch and 2-inch tire.

A pumping station in the city of London, England, is about to be installed with a very large gas engine plant. This plant will consist of eight double cylinder horizontal gas engines, four of which will be rated at 200 H. P. each and the other four of 210 H. P. each. There are to be a number of small engines as auxiliaries. The Westinghouse Machine Company is completing the building of five of these engines, which will be ready for shipment shortly.

In a recent paper "On the Hardening of Extra Hard Steels," M. F. Osmond says that with steels containing 0.35 to about 0.31 per cent. of carbon, there is a gradual increase of hardness with increase of carbon contents; beyond 1.3 per cent. the steel becomes softer. A description is given of the method of investigating the structure of steel by abrasion with the sewing needle, and microscopic examination of the scratch, and it is shown that the structure thus investigated leads to the conclusion that hard steels consist of two interpenetrating types of steel, of which one is much harder than the other. The same conclusion may be drawn by examination of etching of figures, using iodine tincture or dilute nitric acid for the attack.

The importance of the Hamburg harbor is increasing from year to year, says Technische Berichte. According to statistics, 6,790 vessels entered the port in 1885, aggregating 3,704,000 register tons; 1890, the traffic had already increased to 8,176 vessels, with 5,203,000 tons. The subsequent years show the following figures:

	Vessels.	Tons.
1895.....	9,443	6,254,000
1896.....	10,477	6,455,000
1897.....	11,173	6,708,000
1898.....	12,523	7,355,000

Hence the number of tons has been doubled since 1885, and the increase over the previous year amounted to 647,000 in 1898.

American invention, says an English exchange, is just now to the front with numerous mechanical appliances for the automatic production of various classes of goods, and one of the most recent introductions to England is a machine for manufacturing metal hinges automatically throughout. In this process a roll of metal is wound in coils of a large diameter in as long lengths as convenient up to about 100 feet, and is fed through rolls with a cam motion into the machine, where it is gradually manipulated into the separate wings of the hinge. The connecting bolt for the hinges is supplied from a coil on which is rolled a length of wire rod of suitable thickness, and which is fed in at the proper time, as required, the whole operation being automatic, and the hinge is delivered from the machine complete for use, one of these machines having turned out from forty to fifty butt hinges per minute.

An immense cycle factory is being completed at Leeds, England, by the Yorkshire County Cycle Company, Limited, which will be one of the largest in the kingdom, says The American Exporter. The premises have a frontage of 530 feet, with a floor space of 200,000 square feet, and are situated right in the heart of the city. A siding runs from an adjacent colliery into the works, and will supply coal at a figure unheard of in cycle factories. When everything is in running order, it is expected that the works will have a capacity of 2,000 complete sets of parts per week. It is worthy of note that the factory is being stocked with the latest American automatic machinery, the company having sent an expert to this country, giving him ample funds and carte blanche to buy whatever was necessary. His purchases are now being set up in the factory, and specimens of the work turned out by them have been shown in England and praised in the highest terms.

A new method of measuring distance was used by the second corps of the Intercontinental Railway Commission on their work in Costa Rica. This is described in their report as follows: "For the survey we were obliged to extemporize an acoustic method, bandying yaps to and fro three to five times at each station by the watch second hand, thereby ascertaining both direction and distance. Testing the method on open ground, it never differed more than 6 per cent. from stadia measurements. The averages of the two methods would probably be about the same. Our experience gave us great confidence in it. Indeed, no other, no better device, at least, could be thought of if we were to make reasonable progress in such a country. Drums, gongs, or the like thump-sounders might be an improvement on the voice and carry farther, but the voice has the advantage of being itself lighter to carry, an advantage very considerable. For long shots blank cartridges might be used, but we had none of these to spare, owing to the Savagre wreck."

The use of cast steel locomotive frames is making headway in the United States. The first large single order is that for twenty-five consolidation engines for the Atchison, Topeka, and Santa Fe, now in the shops at the Baldwin Locomotive Works. For these the Standard Steel Company furnished a few frames, but much the greater part, says The Railway Gazette, are from the American Steel Casting Company, and were made at Thurlow. These frames are 24 feet $4\frac{1}{2}$ inches long, and finished to 4 inches wide by $3\frac{1}{2}$ inches to $5\frac{1}{2}$ inches deep. Each side weighs rough about two tons. The rough weight has gradually been reduced until in the latest forms delivered it is about 1 ton 17 cwt. The frames cannot be cast so straight that they can go directly to the planer. The great length of the casting as compared with the gross section is such that some drop at one end is unavoidable, and there must be more or less heating and straightening in the forge shop before the frame is put on the planer. This straightening is, however, no more than must be done to a forged frame after it is welded up. The machining now costs more than that of a forged frame. The material is tougher than wrought iron, and the tools must be run more slowly and with a lighter feed.

MISCELLANEOUS NOTES.

The New York forest preserves, during the past year, were increased by the purchase of 309,808 acres of land, for which \$1,304,572 were paid, says Engineering News. The expenses of the Forest Preserve Board for 1898 were \$30,037. The price paid per acre varied from \$1.50 to \$7, the latter price being allowed for totally uncut timber land. Included in the late purchases was the upper half of Saranac Lake, with over forty other lakes and ponds; this territory is extremely valuable for cottage and camp sites, and the price paid \$6.02 per acre. A tract of 30,000 acres, in Franklin County, was purchased at \$5.50 per acre for the State College of Forestry, connected with Cornell University. This was in accordance with the late act of the Legislature providing for the establishment of this College of Forestry.

The world's product of tobacco is estimated at about 1,900,000,000 pounds, valued at about \$220,000,000. Of this the western hemisphere raises about 650,000,000 pounds, the United States contributing 480,000,000 pounds, and Cuba, whose tobacco is the widest known and most highly esteemed, only producing 62,000,000 pounds. Europe raises about 500,000,000 pounds; the East Indies, 400,000,000 pounds; Australia, 10,000,000 pounds; and Africa not enough to be counted. By the addition of our new territories the United States will increase her product by Cuba, 62,000,000 pounds; Puerto Rico, 8,800,000 pounds; and the Philippines, 45,000,000 pounds, which will give us a total of 603,800,000 pounds. Of the States in the Union, Kentucky leads with about 185,000,000 pounds, which is far in excess of any other State, North Carolina coming next with only 40,000,000 pounds, and Virginia next with 35,000,000 pounds.

William Stanton Slocum, of Boston, says that the first solid-headed pin made, either in Europe or America, was made by Samuel Slocum, who was born in Richmond, R. I., in 1792, and died in Pawtucket in 1861. In 1830, Mr. W. S. Slocum says, Samuel Slocum was in the Isle of Wight, and there invented a machine to make board nails, which up to that time were made by hand. The idea came to him that pins, which then were made by winding a fine wire on the head and fastening it to the post of the pin, might be made in an improved manner on a principle similar to that of his nail-making machine. It took him some time to develop and perfect this idea, and finally he shut himself in a room and remained there for eight days, seeing no one and having his meals passed in to him, at the expiration of which period he was able to proclaim his task completed. That was in 1831. The invention passed finally to the concern now known as the American Pin Company, for which Mr. Slocum also invented, subsequently, a machine to set the pins in papers. Mr. W. S. Slocum's observations were called out by an article on pins published in The Sun a few days ago.

Mr. Burton, of Indianapolis, has two novelties in his home. One is a clock which has not been wound in three years and six months, but which has run all the time. It is wound by a more reliable agency than anything human. It may be said to be wound up by the solar system. In this invention the axiom of heat expanding and cold contracting is the basis. The clock is wound by changes in the temperature, the principal force being in the day and night differences. Mr. Burton found that there is an average difference of 20 degrees in the temperature of the night and the day. The day, of course, is the warmer. The heat of the day expands the atmosphere and the lower temperature of the night contracts it. This is how Mr. Burton applied the force to his clock—an ordinary old-style clock—using a weight: Outside of his house he has a tin tank, 10 feet high and 9 inches in diameter. It is air-tight. From it a tube runs into the cellar. This tube leads to a cylindrical reservoir, which receives the air from the tank. In this reservoir there is a piston, whose rod moves with a ratchet between the chain on which the ratchet depends. The heat of the sun expands the atmosphere in the exterior tank, thus forcing any excess into the reservoir near the clock. During expansion the piston rises. In the night time the contraction of the air in the exterior tank reduces the air in the reservoir, and the piston lowers itself. The ratchet arrangement winds the clock.—Indianapolis News.

Chemical Nature of the Purple of Cassius.—Zsigmondy (Annalen) has made an investigation to ascertain the chemical nature of the purple of Cassius. Experiments showed that precipitates containing more than 40 per cent. of gold dissolve in ammonia, but to cloudy solutions which soon deposit part of the gold. Precipitates richer in tin dissolve to almost clear solutions, which may be boiled and kept for months without alteration. A mixture of 200 cubic centimeters of gold chloride solution, containing 8 grammes of gold per liter, 250 cubic centimeters of stannous chloride, containing 3 grammes of tin per liter, and 4 liters of water with a slight excess of hydrochloric acid was made. After three days the purple had deposited and left a solution free from gold and tin. The precipitate, after well washing and ignition, contained 40.3 per cent. of gold and 59.7 per cent. of stannic oxide. The dry precipitate was insoluble in strong and dilute alkalis, but when moist, it dissolved in water in the presence of small quantities of acids or alkalis, though it was insoluble in strong alkalis. Traces of alkalis were sufficient to effect solution. Salts and excess of alkalis and acids precipitated the purple from this solution. The purple did not pass through the membrane of a dialyzer. Colloidal stannic acid was prepared by washing the precipitate which forms in very dilute stannic chloride solutions. This colloid showed practically the same solution phenomena as the purple of Cassius. By precipitating mixtures of solutions of colloidal stannic acid and colloidal gold with dilute acids or salts solutions, substances were obtained of the same color as the gold solution (red, violet, and blue), and possessing all the properties of the purple. Purple of Cassius is thus to be regarded, says the author, as a mixture of colloidal gold and colloidal stannic acid. The gold acquires its property of dissolving in acids through the presence of the stannic acid which is soluble in them. "A mixture of colloids may behave as a chemical individual; the properties of one body will be hidden by the properties of the other."—Druggists' Circular.

SELECTED FORMULÆ.

Estimation of Calcium Carbide.—For the approximate estimation of calcium carbide, the Internationaler Pharmaceutischer Generalanzeiger recommends the following process:

"Fill a 500 grammes flask with distilled water and weigh. Then throw in 1 gramme of carbide and close with a cork, through which a short glass pipe is fixed. The glass tube of an eye-dropper may be employed with advantage, the point reaching into the interior of the bottle. The purpose of this precautionary measure is to prevent that portions of the calcium carbide are lifted up by the current of gas, and are thus allowed to pass out through the glass tube.

"The flask thus prepared is immediately turned over and placed in a vessel containing water. Keep the glass tube closed with the finger as far as below the surface of the water. After the generation of gas is finished, lift the flask out, observing the same caution and weigh again. The difference in weight indicates the number of cubic centimeters of gas.

"Although this method is not mathematically accurate, it is perfectly sufficient in ordinary practice, especially when it is desired to compare different commercial varieties."

Kid Glove Cleaner.—

Soft soap 1 ounce.
Water 4 "
Oil of lemon $\frac{1}{2}$ drachm.
Precipitated chalk, a sufficient quantity.

Dissolve the soap in the water, add the oil and make into a stiff paste with the chalk.

Printing Ink.—The chief coloring matter employed in making black printing ink is said to be lampblack. Bone black is unsuitable alone, but is sometimes used in admixture with lampblack. Prussian blue used in small proportion deepens the tone and indigo is used for the same purpose. These or other pigments when colored inks are required are mixed with a resinous vehicle, the result being a variety of paint. This vehicle is usually a combination of linseed oil, resin, and soap. The first two form the adhesive material, while the last two are said to cause the ink to adhere uniformly to the face of the type; to coat it completely with the smallest quantity; to leave the face of the type readily and easily attach itself to the paper; to wash readily from the type; and to prevent (in a measure) the formation of a "skin" on the ink. An excess of soap tends to give a bad "distribution," and consequently uneven impression, and hinders drying, so that the ink "sets off" when the printed sheets are pressed.

To produce a printing ink of good quality the following process has been given:

Put 6 quarts of raw linseed oil into an iron pot of 4 or 5 gallons capacity and heat until the escaping vapor will burn. Remove the heat and allow the vapor to burn until a drop of the oil when cooled can be drawn out into strings half an inch long. Then extinguish the flame by placing the cover on the pot and stir until frothing has ceased. Then gradually add 6 pounds of resin, and when that has dissolved $1\frac{1}{2}$ pounds of dry brown or turpentine soap, in fine shavings, stirring well after each addition. Lastly, replace on the fire and bring to a boil. This constitutes the "varnish," to which any desired color may be imparted by grinding into it by means of a paint mill or a slab and muller any suitable pigment.

For black the following addition to the quantity of varnish above prepared is recommended:

Prussian blue 5 ounces.
Mineral lampblack 4 pounds.
Ordinary lampblack $3\frac{1}{2}$ "

When a colored ink is to be made, a suitable pigment is substituted for the lampblack and blue in the foregoing formula, and white soap for the dark-colored article.

Copaiba and Venice turpentine are sometimes used in the making of varnish for the finer kinds of ink.—Druggists' Circular.

Fire Extinguishing Liquids.—One of the best agents—probably the best—is aqua ammonia, without any addition whatever. We have personally had experience with the almost marvelous power of this substance in this direction. In one instance, where fire had originated, probably from spontaneous combustion, in a pile containing several tons of cotton seed, and the interior of which was almost a solid body of live coal, a half gallon of ammonia completely smothered the fire. In another, which occurred at Savenay, France, the vapors of a tank containing 50 gallons of gasoline caught fire in the linen room of a laundry. The room was instantly a mass of living flames, but a gallon and a half of ammonia water thrown into it completely, and almost immediately, extinguished the fire. The ammonia was in a glass demijohn in an apothecary shop next door to the laundry, and was thrown into the room by the druggist as an experiment. So completely was the fire extinguished that workmen were enabled to enter the room almost immediately, where they found the iron tank of gasoline intact.

Next in order as an extinguisher comes carbonic acid gas.

The following was patented in France several years ago, after numerous public exhibitions of the ability of the liquid to subdue fire. Make six solutions, as follows:

1. Ammonium chloride 200 parts.
Water 20,000 "
2. Alum, calcined and powdered 350 "
Water 10,000 "
3. Ammonium sulphate powdered 3,000 "
Water 5,000 "
4. Sodium chloride 2,000 "
Water 40,000 "
5. Sodium carbonate 350 "
Water 5,000 "
6. Liquid waterglass 4,500 "

Mix the solutions in the order named, and to the mixture, while still yellow and turbid, add 20,000 parts of water. Let stand, and when the precipitate has settled, decant the clear liquid into thin blue glass containers, each holding from three pints to a half gallon.—National Druggist.

APPROVED LIGHTNING PROTECTION.

A Short Treatise on the Historic and Modern Lightning Rod and its Daily Incorrect Application.

By NEVIL MONROE HOPKINS.

PROMINENT among noted omens in ancient history by which the minds of men have been influenced, and upon which future events are recorded as dependent, may be mentioned the brush discharge of blue fire which appeared at the spear tips of Caesar's army when on the march with fifteen thousand men. The night, though black, was vividly streaked with lightning flashes, accompanied by wind and rain of terrific violence. A halt was allowed the rain-soaked warriors, who, lounging, leaned upon their spears until universal surprise and admiration superseded the weariness and monotony of the march. The soldiers, of a nation carrying the science of omens to the most profound depths, were greatly roused by this manifestation, and entered into the battle which followed with greatly stimulated vigor. This record, undoubtedly as accurate as the writings descriptive of the great range of kings, will at once be appreciated by those who have observed the bright blue plumes of light streaming from the mast tops of vessels when subject to the inductive effect of an electrically charged cloud.

Owing to the frequent incorrect installation of lightning conductors on our modern buildings, and widespread ignorance among those engaged in erecting rods, it is largely of this inductive effect that this article treats, graphically illustrating a comparatively simple phenomenon, widely regarded as abstract, and generally misunderstood by the non-technical student. It would, as matters stand to-day, be a difficult task to bring to the popular mind any device in the entire equipment of electrical science which is regarded with greater skepticism and distrust than the old lightning rod. It is to be regretted that in these days of practical electrical engineering, a science exact in every meaning which may be given to the term, a device should exist and be intimately associated which in any way tends to belittle the dignity and precision of its neighboring sister appliances. During the many decades of service and constant exposure to the elements of various climes, this historic apparatus has acquired a reputation of composite character, if we may so term it, possessing, as it does at the present time, as many standing to condemn, perhaps, as it has to advocate.

Conductors are looked upon by many as a source of danger, they holding that the presence of a metallic rod so prominently located enhances electrical attraction, drawing bolts from the clouds which it is seldom capable of parrying or safely conducting to earth when struck. Although the old conductor of Franklin, but partially correct in application, carefully insulated from the building to which it was attached, occasionally, or we may, perhaps, say frequently, failed to afford protection when actually struck by a lightning bolt, it may be safely asserted that thousands of buildings have been silently shielded from demolition and the dwellers unconsciously protected through the silent equalizing action of the old rod dependent upon the effect of static electrical induction. This electrical phenomenon, but imperfectly anticipated by the old inventor philosopher, yearly caused his rod to shield these buildings without receiving credit, because of the silent and, apart from the glow of blue light at the rod tips, undemonstrative action. Franklin's rod was, and is yet, carefully kept from contact with the building by mounting it upon glass insulators, overtopping gables and chimneys for the purpose of receiving a lightning stroke should an electrical cloud come dangerously near, and of offering it a metallic path to earth, which it should follow in preference to that offered by the material of the building.

The correct and true rod should not be erected to actually receive a lightning stroke, but to prevent any flash from taking place by a quiet, equalizing action. This rod, for reasons which will be made clear presently, should emphatically be applied without insulators of any description, and every effort should be made to mount it in good contact with the roofing, spouting, and all masses of metal on the building. The Roman soldiers were in good contact with their spears, rendered effectually conductive by the downpour of rain, which undoubtedly allowed of a most vivid glow of the electric fluid in the form of plumes of light, neutralizing the electricity in the clouds and constituting a more effective lightning protection than the specially designed rod of the famous philosopher. The correct conductor is virtually the old rod erected without insulators, with certain important modifications, and yet the lightning rod men adhere largely to the old condemned principle in the face of the thoroughly approved and indorsed change in construction by the leading electricians of the world. Let us first take up and analyze this question of induction and discuss just why the change of discarding insulation must be made in order to conform with electrical law.

In order to make a popular investigation of the phenomenon of static electrical induction, it is desirable to go to the bottom of things and introduce the matter graphically, illustrating practical apparatus for the purpose, and describing actual working experiments as far as possible, demonstrating step by step the inductive influence of electrically charged bodies over bodies in a neutral state. An insulated body charged with either kind of electricity, that is, either positive or negative, acts upon a nearby neutral body by attracting the opposite electricity and repelling the like. This is also true in magnetism, and may be demonstrated by experimenting with bar magnets with their north and south poles.

A neutral body may be looked upon as a mass containing both positive and negative electricity, but in a combined state, with no signs of either existing. This state of affairs may be compared with a stable chemical body—water, let us say—which remains passive until disturbed by the proper influence, when it yields free oxygen and hydrogen gas. For the introductory representation of static induction, illustrated from a working experiment, the reader is referred to Fig. 1. Here we have at A the positive electrode of an electrical machine mounted upon an insulating column. The metal cylinder, B, at the right is also carefully insulated by means of a glass column and is provided with a couple of upright wires, as shown, carrying pith balls suspended from bits of moistened lines.

thread. The electrical machine could be made to furnish negative electricity instead of the positive, and the phenomenon of induction would be equal in effect, but the induced charge would, of course, be opposite in sign.

For our purpose throughout the discussion we will

tricity, and try its effect on the ball at the left. The ball will now be attracted and the ball at the right will be repelled. This shows in a very conclusive manner that the graphic representation in the drawing is correct. We may also show experimentally, by exploring with pith balls, that the charges are confined to the

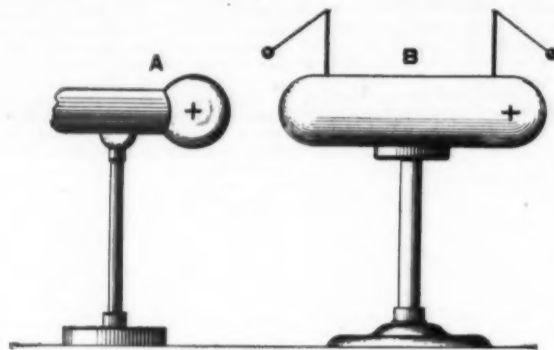


FIG. 1.—INDUCING A CHARGE INTO NEUTRAL CYLINDER.

take positive electricity as the inducing kind, merely for the sake of clearness and uniformity. Referring once more to the figure, we see the charges or kinds of electricity represented respectively by the positive and negative signs. Upon approaching the neutral cylinder, B, with the positively charged knob, A, of the electrical machine the compound of electricities is decomposed, negative electricity being attracted at the left next the machine and positive electricity being repelled to the right remote from the machine. The

ends of the cylinders, the negative being attracted as far as possible to the left and the positive repelled as far as possible to the right. Tests with pith balls at the center of the cylinder will show only the feeblest signs of electricity, if any effect can be produced at all. If now, while the pith balls are swinging out, the knob of the electrical machine is moved away, the free electricities will recombine and the balls will fall and exhibit no further electrification. Let us bring the knob of the machine once more in proximity to the cylinder

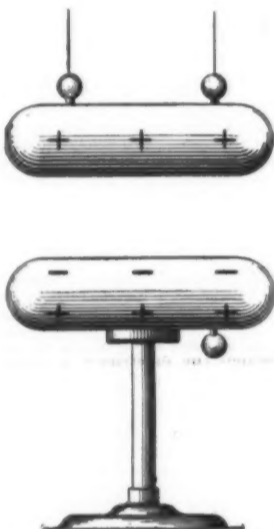


FIG. 2.—INDUCING A CHARGE INTO INSULATED CYLINDER.

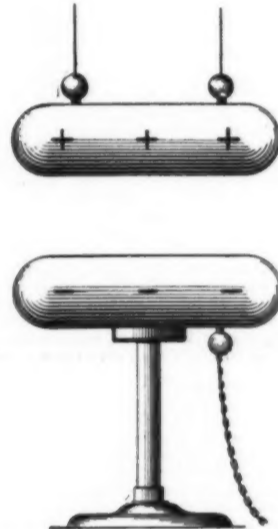


FIG. 3.—INDUCING A CHARGE INTO CYLINDER CONNECTED WITH EARTH.

illustration represents this state of affairs, with the pith balls swinging out from the ends of the cylinder and affording us ready means for testing the kind of electricity at either end, which is done by approaching the balls with excited sealing wax and glass rod respectively. When sealing wax is rubbed with dry flannel, it exhibits negative electricity, and if brought near the pith ball at the left of the cylinder, the ball will be repelled by it, showing that it is charged with the same kind of electricity, namely, negative. If the

and again establish induction. If the remote end of the cylinder is connected with the earth by means of a chain, the positive electricity will be repelled still farther from the knob of the electrical machine, that is, through the chain into the earth. The negative electricity will remain, however, being attracted and bound in position by the charge of opposite kind on the machine.

If, under the existing circumstances, the knob of the machine is brought still nearer the end of the cylinder,

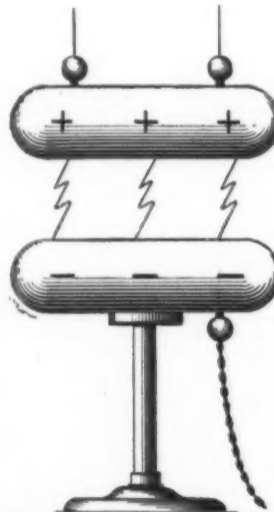


FIG. 4.—SPARKS PRODUCED BY LOWERING UPPER CYLINDER.

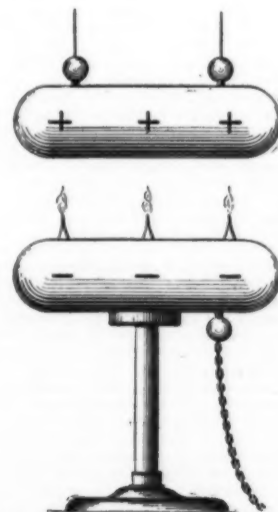


FIG. 5.—FLAMES PRODUCED BY EQUIPPING LOWER CYLINDER WITH POINTS.

sealing wax is brought near the ball at the right, the ball will be attracted, showing that the ball has unlike electricity from the sealing wax, namely, positive.

To carry the proof still farther, we may rub a glass rod with a silk scarf, thus producing positive elec-

the attraction between the two electricities will be too powerful for the intervening strata of separating air, and a disruptive spark or series of sparks will pass, until the unlike electricities have combined, and become a neutral compound. Let us now imitate more

closely a charged cloud, and represent more perfectly a body on earth, such as a building. In Fig. 3 we have, instead of the knob of the electrical machine, a suspended metal cylinder resembling a cloud, conveniently connected with the positive end of a powerful, constantly excited electrical machine, capable of giving an eighteen inch spark in air. Below we have a second cylinder to receive the induced electricity, which we will consider to be the building. This lower cylinder

We can now most effectually prevent these sparks from striking between these two bodies by attaching to the lower cylinder a few sharp metal points, directly connected with the cylinder. When this is done, and the upper cylinder descends again within the danger range, there will be no violent disruptive sparks, but a quiet, bluish glow will be seen at the point tips which will neutralize in a few seconds the dangerous charges as completely as if the electricities had rushed together

and roof, and decreases gradually in density as the ground is approached. There is to be seen a brush glow at the rod tip, the well known glow of many years.

If the cloud approaches within its striking distance, a bolt of lightning will pass, perhaps a series of bolts in rapid succession, until the two charges are neutralized. The rod may receive the blow, and it may not; in either case, considerable destruction is liable. The glow at the point, when the conductor is effectually insulated, is due to the electricity from the earth, as shown by the arrows on the ground plate. With the rod perfectly insulated, there is no escape for the dangerous charge on the roof, except by a flash of lightning. If the rod is an old one, with a number of insulators missing, and the roof has been soaked by a down-pour of rain, the old conductor will do fairly good work; and if there are several under such circumstances connected to a building, a flash will more rarely take place.

It is probably from this rain and leakage, ineffectual insulation, etc., that Franklin's apparatus has proved most efficient. At the right in this figure is depicted an end view of a similar house, possessing a blunted rod at the tip and a break in the continuity of the conductor, as shown at C. This is a very common condition of lightning rods, and it is at once apparent that the rod is of no value.

Let us now consider the uninsulated system and the proper modifications. Fig. 7 illustrates the action of the direct connected conductor without the improved modifications, which will be dealt with separately, for the sake of simplicity and clearness. Here we have the same inductive cloud, but with the rod in direct contact with the roof. The dangerous induced negative charge rushes to the conductor, as indicated by the arrows, and streams off from the point to the cloud. If this streaming can go on fast enough, the electricities will be silently neutralized; but if the charges are too great and the affinity between them too strong, a bolt will pass; but to the rod in this case, in preference to the building, because the streaming action tends strongly to lead the discharge to the point of the conductor.

In order to still farther prevent an actual discharge from taking place, it is necessary to modify this simple installation by putting several conductors to each building, each carrying a number of attached connections branching out in contact with the roofing, spouting, etc., and mounting numerous sharp points. With a number of sharpened tips, in proper proportion to the number of square feet on the roof, the chances of a stroke taking place are reduced to a minimum. The earth plates should be of copper, and of generous proportions, and be buried to a depth of at least 15 feet in damp earth. It is suggested by a number of authorities on lightning protection that the earth plates be buried under rain spouts in order that the rain water will soak down to the plates and insure a good ground. As the rain does not come up, very frequently, until the electrical demonstrations have become violent, or perhaps the damage wrought, the writer recommends the placing of water spigots connected with the plumbing in the localities of the ground plates. In this manner the ground may be dampened to a great depth in a few minutes by simply opening a valve. The discharge of the rain spouts is, of course, of great value, as the rains between electrical storms tend to keep the ground in good condition for protection, provided no draught occurs.

Before describing the ideal modern rod equipment on the great monument at Washington, the writer deems Benjamin Franklin's description of lightning action of sufficient general interest to introduce here, giving the description of the famous kite experiment in the philosopher's own words. Those who carefully read his directions and inferences can judge for themselves just how far the celebrated inventor of the lightning rod understood the real action of his invention.

"PHILADELPHIA, in America, }
"October 19, 1753. }

"As frequent mention is made in the public papers from Europe of the success of the Philadelphia experiments for drawing the electric fire from clouds by means of pointed rods of iron erected on high buildings, etc., it may be agreeable to the curious to be informed that the same experiment has succeeded in Philadelphia, though made in a different and more easy manner, which is as follows:

"Make a small cross of two light strips of cedar, the arms so long as to reach to the four corners of a large, thin silk handkerchief when extended; tie the corners of the handkerchief to the extremities of the cross, so you have the body of a kite, which, being properly accommodated with a tail, loop, and string, will rise in the air like those made of paper; but, this being of silk, is fitter to bear the wet and wind of a thunder gust without tearing. To the top of the upright stick of the cross is to be fixed a very sharp pointed wire, rising to a foot or more above the wood. To the end of the twine, next the hand, is to be tied a silk ribbon, and where the silk and twine join, a key may be fastened. This kite is to be raised when a thunder gust appears to be coming on, and the person who holds the string must stand within a door or window, or under some cover, so that the silk ribbon may not be wet; and care must be taken that the string does not touch the frame of the door or window. As soon as any of the thunder clouds come over the kite, the pointed wire will draw the electric fire from them, and the kite, with all the twine, will be electrified, and the loose filaments of the twine will stand out every way, and be attracted by an approaching finger. And when the rain has wet the kite and twine so that it can conduct the electric fire freely, you will find that it streams out plentifully from the key upon the approach of your knuckle. At this key the phial may be charged; and from the electric fire thus obtained spirits may be kindled, and all other electric experiments performed, which are usually done by the help of a rubbed glass globe or tube, and thereby the sameness of the electric matter with that of lightning completely demonstrated.

B. FRANKLIN."

The lightning protection of the Washington Monument can now be taken up for description, as it constitutes a most ideal installation of correct conductors. The apex of the monument consists of an aluminum

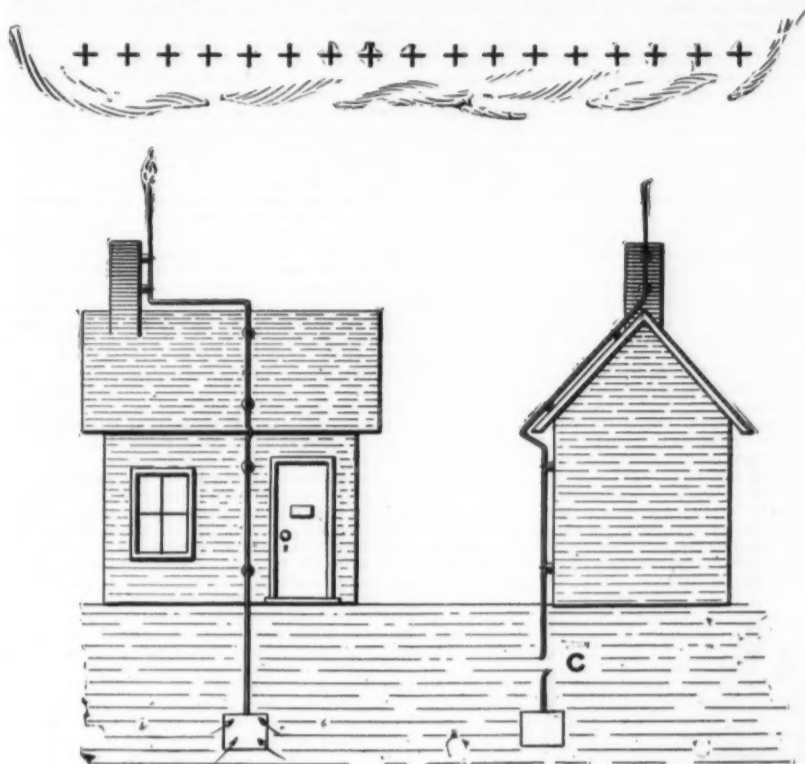


FIG. 6.—ACTION OF INSULATED LIGHTNING ROD.

is seen first insulated on a glass stand, with its neutral electricity decomposed into electricities of opposite sign, precisely as in the case of the first experiment. The negative electricity is attracted by the positive charge of the pretended cloud above, and the positive electricity is repelled as far as possible on the other side. The relation between existing conditions and those in the initial experiment is undoubtedly apparent. Let us now connect the under side of this cylinder with the ground and allow the positive charge to be still farther repelled, that is dissipated into the earth. This is illustrated in Fig. 3, where the negative electricity reigns supreme. We now have the same powerful attraction between the two charges, which may be proved by allowing the cloud cylinder to descend until disruptive sparks pass, as illustrated in Fig. 4. This

in the form of violent flashes. This equalizing is illustrated in Fig. 5. Why do the points act thus? may be the question. It requires but a word in explanation.

The negative charge collects at the highest points of the cylinder in the densest and most dangerous form as it is attracted by the opposite charge. The sharpened points are the highest, and the nearest the attracting force, into which the electricity is unable to collect in any quantity, streaming off as rapidly as it reaches the tips, and completely destroying the dangerous tension by neutralization. This neutralization may well be compared with the mixing together of a concentrated mineral acid and a powerful alkali solution. Either one may be taken as the positive or negative charge, and either one is capable of inflicting great damage, but if the alkali solution is allowed to

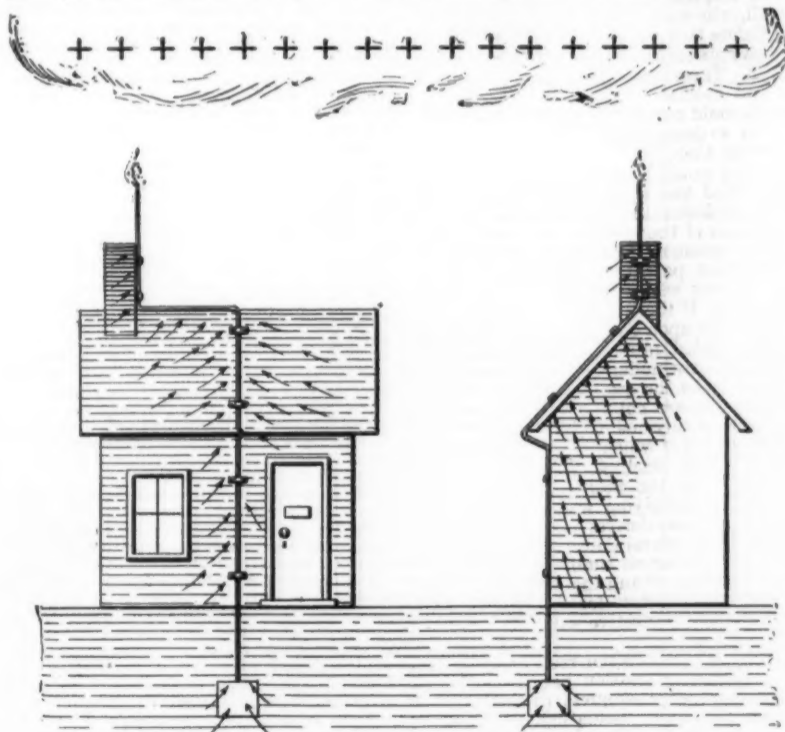


FIG. 7.—ACTION OF NON-INSULATED LIGHTNING ROD.

gives us in substance the true conditions existing between house and cloud, as will be readily seen. Instead of the insulating stand and connecting chain, it is obvious that the cylinder could be placed directly upon the ground, and that the sparks will pierce the intervening air in the same manner, if the charged cylinder is allowed to descend within its striking distance. This is the dangerous state of affairs in actual practice which must be eliminated, and it is this elimination which constitutes the major theme of this article.

run slowly into the acid, the two dangerous bodies will be practically annihilated. Let us now consider a small building directly under the inductive influence of a charged cloud. Fig. 6 has been prepared to bring out the action of the insulated type of rod. The conductor is represented here carefully insulated from the building, and terminating in a metal ground plate. The horizontal shading graphically represents the negative induced charge, and is drawn to illustrate the fact that the electricity is densest at the chimney top

pyramid, to which are attached eight half-inch copper rods extending down to the base of the stone pyramid, whence they are bent inward, and pass through the masonry to the interior of the monument. Four of these rods pass down the four edges of the stone work and four pass down the surfaces. The four edge rods are each tapped or connected at two places by other rods, which are also bent in and pass to the interior of the monument. The running distance of these conductors on the outside of the stone work before they are passed in through the masonry is about sixty feet. These eight conductors are all connected together on the outside by a heavy rod running around the pyramid, and are all gold plated. There are now two hundred platinum tipped points attached to this net work, which point skyward, being in direct contact with the masonry through their numerous mounting rods. We have now sixteen half-inch copper rods passing into the interior of the monument through the stone work of its pyramidion. Let us now see what connection is made with the ends of these rods. They have simply been carried direct to the tops of four stout iron columns, which support the stairway and elevator, and securely connected. These iron columns are in the most direct contact with the shell of the monument by hundreds of stays, beams, and platforms. The iron columns run to the very foundation of the monument, where they are bolted to heavy stone work. Each column is now connected to a three-quarter inch copper conductor, which leads to the bottom of a well twenty feet below the depths of the foundation of the great shaft. This well receives the copper conductors in several feet of water, into which is placed sand to a depth of fifteen feet. This protection is without flaw in theory, and without reproach in its behavior during some of the severest electrical storms, constituting a most severe test, as it deals with electrical clouds in an unchallenged manner, protecting the highest stone edifice in the world. There are numbers of other correct lightning conductors, of course, but the number of correct ones to the number of the incorrect presents a sad showing.

A NEW DEVICE FOR LIGHTING GAS BURNERS.

THE lighting of intensive gas burners presents numerous difficulties. Sometimes the burners are not very accessible, and sometimes it is necessary to assure their preservation, as with incandescent ones. Several systems have already been devised, but in practice they are far from solving the problem.

M. Ceard, an inspector, connected with the lighting service of the city of Paris, has devised a special system of lighting which has been used for a year for the intensive lamps installed upon Place Hôtel-de-Ville. This system consists, in principle, in igniting the burners one after the other by means of the explosion of a mixture of gas and air that furnishes a large volume of gas at a high temperature, and it is the latter property directly that permits of effecting the lighting.

The annexed figure, from *La Nature*, shows the lighter in its entirety at 1 and the different details at 2, 3 and 4. At the side of the gas burner, A, there is a tube, B, of small diameter, the upper extremity, b, of which is near the tip of the burner. At its lower part this little tube communicates to the left with the three-way cock, F, through which the burner is supplied, and is situated beneath the lamp. To the right it ends in the interior of a second tube, D, of wider diameter, which is open at its extremities, g and d, and provided with a tubulure, I. The tube, B, is provided at the side with an ajutage, E, having two orifices—one of them, e, vertical, and the other, f, horizontal. This ajutage enters the tube, D. The lighting is done very easily in the following manner: The three-way cock, F, is opened externally, as shown in No. 1, so as to allow the gas to enter the conduit to the right. The gas escapes through the tube, B, at the upper part, at b, and at the three apertures, e, f, and d. Upon a flame being brought near the side, I, the gas at once ignites and sets fire to the explosive mixture formed at D by the gas that escapes at e and the air that is circulating. This mixture burns and produces a quantity of gas at a high temperature, which, through the orifice, d, lights the burner, b, at the top of the tube, B. The tip, b, afterward lights the principal burner, A, after the cock has been brought to the position shown at 3. This succession of ignitions takes place regularly. When the distance between the upper extremity of the tube, D, and the extremity of the tube, B, is too great, there may be added at b' a second ajutage, as shown at 4.

The burner, A, properly so called, remains inclosed in the lamp, protected from all causes of deterioration. This new system of lighting is interesting and, moreover, is very practical, as has been shown by the years' use of it already mentioned.

THE NATURE AND HISTORY OF PATENT RIGHTS.

By E. L. THURSTON, Esq., Associate Member of the Civil Engineers' Club of Cleveland.*

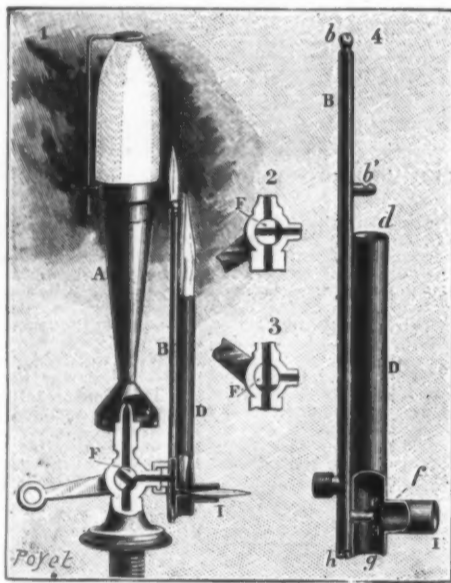
THE patent rights to which this paper relates are those rights respecting an invention which are created by the grant of a patent for that invention.

Until a patent is granted for it, an inventor has no property rights whatever in his invention as such. It is true, he may own the particular machine or instrument in which his invention is embodied, but he has no ownership in the invention itself until the patent is actually granted and issued. In the meantime others may make, use, and sell similar machines or instruments containing the invention without infringing upon any of the inventor's rights. Under the common law, every person has the right to make anything he wishes to make out of materials which he owns, and it is equally his right to sell the thing so made or to use it when and where he chooses, provided such use is not harmful to the public. It is only by the grant of a patent, authorized by the statute laws passed by Congress, that an inventor acquires any special rights or privileges respecting his invention.

The right created and secured by a patent is, to

quote from the granting clause of a patent, "the exclusive right to make, use, and vend the invention throughout the United States and the Territories thereof" for seventeen years. The language quoted is ambiguous and deceptive, and is responsible for a widespread misapprehension as to the nature of the rights secured by the patent. Many persons believe that a patentee has, by virtue of his patent, the absolute right to make, use, and sell his invention; but that is not the fact. The patent secures to him the "exclusive right to make, use, and sell his invention," but to understand just what this right is you must put the accent on the word "exclusive." A patent secures to the patentee the exclusive right to make, use, and sell his invention. The patent is a grant of exclusion, and that only. It secures to the patentee the right to exclude or prevent others from exercising their natural right to make, out of their own materials, the particular article the invention of which the patent covers; and that is the only right respecting an invention which is created by a patent. It does not give or purport to give to the inventor absolute right to make, use, or sell his invention. If he had that right before his patent was granted, he has that right after the grant, but otherwise he has not.

As I previously stated, it is the natural right of every person to make what he wishes out of his own material, but each patent which is granted to another restricts that right. It removes for seventeen years the particular invention which it covers from the group of things which the public may use and sell. There are now in force more than 350,000 patents, each of which acts to thus restrict the natural right of every person except its owner; because, as before stated, the owner of every patent has the right to prevent you and me and everybody else from making or using or selling the invention which his patent covers. Clearly, the grant of a patent to one of us cannot take away the right previously granted to another; and in many cases it would do that if it granted to the patentee the absolute right to make and use his own invention. Most inventions are improvements upon or changes in or modifications of or additions to old things. The first inventor of



THE CEARD DEVICE FOR LIGHTING GAS BURNERS.

every improvement has the right to a patent by which he can prevent others from using it, but he may not be able to make use of it himself, because some previous patent may have secured to its owner the right to prevent others from using some part of the thing improved, without which the improvement is useless.

A familiar example of this condition of things existed for many years with respect to the telephone which was invented by Bell, who was granted a broad patent for his invention. Before this Bell patent expired more than five hundred patents for improvements on the telephone were granted. These improvements were of all kinds—good, bad, and indifferent; but, whether good or bad, the patentees could not use their own patented inventions, because in so doing they would necessarily use Bell's invention and thereby infringe Bell's patent; or, in other words, they would do that which Bell, by virtue of his patent, had the right to exclude them from doing. Under conditions like these there is a sort of deadlock. The owner of the original patent cannot use the improvement without the permission of the owner of the improvement patent, and the latter cannot use his improvement without the permission of the former. Ordinarily, if the improvement is valuable, the two get together upon some equitable basis.

Although, as I have stated, property rights in an invention, as such, do not exist under the common law, and may be secured only by the granting of a patent, inventors in this country are not dependent for the grant upon the caprice of any one. Congress has enacted patent laws by virtue of which the first inventor of any new and useful art, machine, manufacture, or composition of matter has the positive right to the grant of a patent upon complying with certain prescribed conditions. Congress derives its authority to pass patent laws from the Federal Constitution, wherein it is set forth that "Congress shall have power to promote the progress of science and the useful arts by securing to authors and inventors for a limited time the exclusive right to their respective writings and discoveries."

The wise framers of our Constitution recognized these facts, which our history as a nation has abundantly substantiated, viz., first, that progress in the useful arts would be promoted by stimulating invention; second, that invention could be stimulated by offering

a reward to inventors; and third, that the fairest method effecting that result would be to make the reward as nearly as possible commensurate with the value of the invention to the public. In theory, at least, no better method could be devised than that which gives to the inventor for a limited time the control of his invention. He may, within that time, make out of his invention such profit as the public demand for it or its product will yield. If the invention be valuable to the public, the inventor's profits will be correspondingly large. If the invention be of little importance, the inventor's profits will be proportionately small.

The legal machinery for enforcing the patent laws, to the end that the inventor may obtain his promised reward, is not perfect. Like other machinery, it sometimes works better in theory than in practice. I believe, however, that the rights of a patentee may be enforced as speedily and as effectively as can any other right which must be enforced by law.

There are two theories as to the nature of a patent right. Under one theory it is a monopoly. Under the other theory it is a contract between the inventor and the government representing the public.

The contract theory is fortunately that which has been generally accepted by the courts and by Congress in this country. Under the contract theory, the government may be said to have a standing offer to inventors in substantially this form: The government will grant to every inventor for seventeen years the exclusive control of his invention, provided it be new and useful, and provided he will, in the manner and form prescribed, make a full and complete disclosure of the invention to the public, so that the public may understand how to make and use it after the term of the grant has expired.

An inventor is under no obligations to accept this proposition. He may lock the invention in his own mind, where it was born. He may practice it in secret if he chooses to, and if the nature of the invention will permit it. If he does accept the proposition, the public gains the complete knowledge of the invention, and in compensation for this knowledge disclosed by the inventor, he acquires the exclusive right to control the invention for seventeen years.

This exclusive privilege does not take from the public any right which it had before enjoyed, because it is one of the essential prerequisites of a valid patent that the invention must be new. The only hardship which the grant imposes upon the public is that it must for a time either do without that which it never had or that it must obtain the right to use the invention, if at all, upon the inventor's own terms.

In the eyes of the law, it is not unimportant to determine definitely whether a patent is a monopoly or a contract. It is not a mere question of words. If a patent is a monopoly, it is a grant in derogation of common right, and as such it should be construed strictly against the patentee and in favor of the public. The language of the patent should be carefully and critically examined, and whatever is not positively and unequivocally included in the grant, whether invented by the patentee or not, should be held to belong to the public.

If, on the other hand, the patent is a contract, it should be construed, as all contracts should be, liberally and fairly, and as nearly as possible in accordance with the intention of the parties as expressed by the patent. It is always the intention of an inventor to secure complete protection for his entire invention. It is the promise of the government that he shall receive complete protection for that invention which the patent covers. Under the contract theory, the patent should not be subjected to over-nice criticism. If the language employed by the patentee in his claims will permit such construction, it should be construed so as to afford complete protection not only for the particular embodiment of the invention shown and described, but for its mechanical equivalents. This, fortunately, has been and is the attitude of our courts upon this subject. It sometimes happens, however, that the claims of patents are so unskillfully formulated that their language cannot be construed to protect the invention. Under the contract theory, the patent is the contract instrument. The specification and drawings constitute that part of the instrument which discloses the invention, and it is the consideration passing from the inventor to the public. The grant, found on the first page of a patent, is the consideration passing to the inventor from the public, and the claims define the subject of the grant. The claims are brief statements made by the inventor or his attorney which point out which part or parts of the entire thing described the inventor claims to have invented. It is left to the inventor to make his own definition of the boundary of his grant. If he claims too much, the Patent Office will refuse the patent. If he claims too little, the patent is granted only for what he claims, and he loses part of the protection which he might obtain. It is, therefore, very essential that the claims of a patent shall be skillfully drawn, because the courts, while they will liberally construe the claims which are in a patent, will not make new claims and will not construe the claims to mean something which their language plainly does not mean. Many a valuable invention has been sacrificed by unskillfully drawn claims.

Let us now consider briefly the other theory of the patent privilege, viz., that it is a monopoly. The patent right is undoubtedly a monopoly in a limited sense. But it is not an illegal monopoly, as defined by Blackstone and all of the later legal writers. Blackstone defines a monopoly as "a license or privilege allowed by the king for the buying, selling, making, working, or using of anything whatsoever whereby the subject in general is restrained from that liberty of manufacturing and trading which he had before." A patent right is not a monopoly in that sense. It does not, as a matter of fact, deprive any individual of any right he had before, because, as before stated, it is one of the essential prerequisites of a valid patent that the patented invention must be new. It must never have been known to or used by others before the inventor originated it. And no individual can be said to have been in actual possession of a right when neither he nor anyone knew how to exercise that right. The patent right is monopolistic in form only, but so also is every property right. A man who owns a horse or a house, or any other thing, has, by virtue of that ownership, the exclusive right to use that thing.

* Read before the club December 13, 1898.

The theory that the patent privilege is a monopoly had its origin in the fact that the early history of the British patent system, of which our patent system is the direct descendant, is inseparably connected with the history of those illegal monopolistic grants by the English kings against which the famous statute of monopolies was aimed.

Briefly, the early history of the birth and growth of the British patent system is the following: In the early history of trade and manufacture in Europe capital was timid. It needed encouragement and protection. The people in those days were not strict observers of the rights of property. Might made right. The beginning and carrying on of trade and business was hazardous. Communication between different cities and countries was difficult and dangerous; and the assurance of large profits upon successful ventures, to balance losses upon unsuccessful ventures, was necessary to tempt capital into trade, and especially to induce merchants to engage in foreign trade, which would bring into the country new manufactures; that is to say, new manufactured things and the knowledge of the art of making them. To encourage capitalists to enter trade and manufacture, the English kings at an early day began to exercise their royal prerogative by granting special privileges to such persons. The promotion and development of towns as centers of domestic trade and manufactures were also encouraged by royal grants of political immunities or commercial franchises.

Practically all of the early royal grants of special monopolistic privileges had been made directly to merchants, or to manufacturing or trading companies, as inducements to enter business, or as rewards for having done so. But later the crown began to grant monopolies for money paid or for services rendered to the crown. Monopolies were sold by the crown to persons who sold them again at a profit. Favorites were rewarded by grants of monopolies; and this evil increased until competition was destroyed and trade in almost all commodities was controlled by a few individuals, who put upon these commodities whatever price they pleased. Such common articles as salt, iron, powder, vinegar, bottles, oil, starch, paper, etc., were the subject of monopolies.

Grants of this character took from the people rights and privileges which they had before enjoyed, and were consequently odious monopolies; and the burden of them became so great that in the reign of James I. (1603) the famous statute of monopolies was finally enacted by the British Parliament, and the king was forced to sanction it. By this statute all past monopolies were abolished, and the power of the king to grant others was expressly denied, except where such grants had been or should be made to inventors of new manufactures, conferring upon them for a limited time the exclusive right to practice their inventions.

Prior to the enactment of this statute two classes of monopolies, widely different in both their legal and intrinsic characters, had been granted in England. The first class, and the earliest to be granted, comprised those which conferred upon the inventors of new manufactures, or the introducers of a new trade into the realm, the exclusive right of carrying on that trade or manufacture for a specified period. The English courts always sustained these grants as the proper and legitimate exercise of the royal prerogative.

The second class deprived the public of the right to make or sell those things which before the grant they had the right to make or sell. The grants of this class were always treated by the English courts as odious and void at common law. But, since the courts had no power to prevent the crown from making such grants, they could only punish the monopolist for procuring them and prevent him from exercising them; and these things they invariably did when occasion offered itself.

The statute, therefore, merely enacted into statutory law those principles which the English courts had always declared to be the common law of England.

The framers of our constitution were well acquainted with those principles and with the reasons which induced the English courts to sustain grants of special privileges to inventors. They recognized both the justice of such grants and the advantages which wise patent laws would bring to the public, and they therefore incorporated into the constitution that clause which I have quoted.

Acting under the authority thus conferred, one of the early acts of Congress was to pass the first patent statute, which went into effect April 10, 1790, and was entitled "An act to promote the progress of useful arts."

The act of 1790 specified the subjects for which patents might be granted as the "invention or discovery of any useful art, manufacture, engine, machine, or device, or any improvement thereon not before known," and patents were granted for fourteen years. The act remained in force about three years, and only fifty-five patents were granted under it. The first patent granted under this act was dated July 31, 1790, and was granted to Samuel Hopkins for making pot and pearl ashes.

On February 21, 1793, another act took the place of that of 1790. Under this act the applicant for a patent was required to make oath that he believed himself to be the true inventor. This was not required under the act of 1790.

By an act passed February 15, 1819, an important change in the mode of administering and enforcing the patent law was introduced. Under the previous acts all suits for infringement of letters patent were necessarily suits at law for damages. Under the act of 1819 the circuit courts of the United States were given jurisdiction in equity, as well as in law, of actions for the infringement of patents, with power to grant injunctions to prevent the violation of the rights of the inventors. No other provision for the protection of the rights secured by patents has been so effectual as this power to restrain infringements by injunction. It is constantly invoked. In fact, nearly all patent suits for many years have been suits in equity asking for an injunction, among the other reliefs prayed for. Without this right of granting injunctions the courts could not practically secure to inventors the exclusive right to their inventions which is contemplated by the constitution.

By the act of 1833 the right was conferred upon a patentee to reissue his patent, provided the patent is

inoperative or invalid for certain reasons stated which arose through inadvertence, accident or mistake, and without any fraudulent or deceptive intent on the part of the inventor. The reissued patent was to remain in force during the unexpired term of the original patent. This right to reissue a defective patent has been retained in all of the subsequent acts, with no substantial change in the conditions prescribed.

During the period of a little more than forty-six years after the enactment of the first patent statute, in 1790, the number of patents granted was a few over 6,000, a number now greatly exceeded in every period of four months. During the past forty-six years the number of patents granted is over 600,000. The greatest number of patents granted in any one year prior to 1836 was 751. The number granted in the last twelve months is over 20,000.

In 1836 all of the preceding acts were repealed, and a new act was passed by which was inaugurated a new system for the granting of patents. The act of 1836 introduced a radical change in the patent law, so far as it related to the granting of patents. It created an office or bureau to be called the Patent Office. The act provided for the appointment of a Commissioner of Patents, who was required to superintend and perform all duties touching the granting of patents. The conditions under which an applicant was to be entitled to a patent were substantially the same as under the act of 1793, except that foreigners were placed on the same footing as citizens in all particulars, except as to the amount of fees paid. The term for which patents were granted was, as under the previous acts, fourteen years; but an important innovation was introduced in favor of patentees. Provision was made for the extension of a patent upon the expiration of the term for which it was originally granted for a further term of seven years, if it should be made to appear that a patentee had failed, without neglect or fault on his part, to obtain a reasonable remuneration for the time, ingenuity, and expense bestowed upon the invention, having due regard for the public interest. The right to the extension of a patent was taken away by the act of 1870, by which act also the original term of a patent was made seventeen years.

Another important feature of the patent law introduced by the act of 1836 was the provision for the registration in the Patent Office of assignments of patents or individual interests therein, and of all grants of exclusive rights to an invention in specified territories. This change gave a security to the title of a patent similar to that given to a title to lands by a registration of deeds.

The most important change, however, introduced by the act of 1836 was the power given to the commissioner to decide whether an applicant was entitled to a patent under the provisions of the statute. In the discharge of this duty it was incumbent upon him to make, or cause to be made, an examination of the new invention for which a patent was asked. If, on examination, it should appear to him that the invention had not before been made in this country, or that it had not been patented or described in a printed publication, and had not been in public use or on sale with the applicant's consent or allowance prior to the application, the commissioner should, if he deemed it sufficiently important and useful, issue a patent therefore. No such examination, to be made previous to the issue of the patent, had been called for by the previous acts or by the law of any other country. It has proved to be one of the most valuable and important features of the patent system, and, in one form or another, it has since been provided for by many of the nations which grant patents for inventions.

Under the act of 1793 a patent was granted to an applicant if he made oath that he believed that he was the first inventor of the invention. If he was mistaken his patent was void when the mistake was shown. It is obvious that in most cases it would be impossible for an inventor to know with certainty what had been done before, and the expense of an examination of the state of the art would be too great for most if not all inventors. Without such examination no purchaser of a patent could feel any assurance that the patent would not prove to have been anticipated and under the act of 1836 it was made the duty of the Commissioner of Patents to make the examination which the inventor in most cases could not make himself. The cost of the examination was covered by a fee of \$30, which the applicant was required to pay. To provide facility for the examination, the act provided for the establishment of a library of scientific books, and appropriated \$1,500 for its acquisition. This library has grown now to contain nearly 60,000 volumes.

It is true that the examination thus provided for was not to be conclusive, and a patent might be found to be invalid notwithstanding the examination. A defendant in a suit has the right to show, and often does show, that a patent is void for want of novelty or invention; but, though the examination is not conclusive and binding upon other persons, it is valuable both to inventors and to the public. The records show that nearly half of the applications for patents which have been made during the past five or six years have been rejected because the supposed inventions were found not to be novel. Under the old practice patents would have issued on all these rejected applications without benefit to the inventor, and to the annoyance of the public. The strong presumption which the examination furnishes that the subject matter of the patent is new, and that the patent is therefore valid, gives a value to it from the moment of its issue which it would not otherwise have, and increases very much the security of the investment of money in it. Very few inventions can be made profitable without a considerable outlay. Few inventors have the necessary money to develop an invention and place it upon the market, and few men who have the money could be induced to invest it in a patented invention except for the confidence which this system of examination gives in the validity of patents.

Another important duty imposed upon the Patent Office by the act of 1836 was the power to investigate the claims of two or more inventors to the same invention, and decide which was the first inventor. Cases of this kind, known as "interference cases," often arise.

Another important change in the patent law was introduced by the act of 1839. Under the act of 1793 the inventor lost his right to a patent if the invention had

been known or used by others before he made his application. To avoid the risk of having the invention put into use by some one else, and thus losing it, he was compelled to make his trials in secret. Sometimes the nature of the inventions made this impossible. The act of 1836 relieved him from the liability to loss from the use of the invention by others unless it was with his consent and allowance. But, in order to give an inventor the opportunity to test his invention by actual use without risk of his losing his right to a patent, the act of 1839 provided that no use of an invention by the public, either with or without the consent of the inventor, should deprive the inventor of his patent unless the use had been made for more than two years, or upon proof of abandonment. The act of 1836, with the amendments of 1839, virtually determined the character of the patent law as it exists to-day.

There were no substantial changes in the patent laws after 1839 until 1870, when, as before stated, the term of a patent was changed from fourteen to seventeen years.

Last year the patent laws were again amended in some substantial respects, and the amended law went into effect on January 1, 1898. Before that time the first inventor was entitled to a patent for his invention, provided it had not been in public use or on sale in the United States for more than two years before he filed his application. Under the new law he loses his right to a patent if his invention has been patented abroad, or has been described in any printed publication in this or any country more than two years before his application is filed.

Another provision of the new law relates to the effect which a prior foreign patent has upon a United States patent. Under the old law a patent granted in the United States for an invention previously patented in some other country would expire with the first expiration of a foreign patent. This law sometimes worked great hardship to American inventors in this way. It takes a long time for some cases to secure the allowance and issue of a United States patent, while in many of the foreign countries the patent is granted very soon after the application is filed. The inventor ordinarily desires to exploit his invention in this country as soon as possible, and generally begins to do so at least as soon as he files his United States application. The public thereby gained the knowledge of the invention. In some of the foreign countries the laws permit the granting of a valid patent to the first applicant. In England whoever first introduces into the realm the knowledge of the invention is regarded as the inventor, and he is entitled to the patent to the exclusion of the man who originated the invention. Any one, therefore, who learns of an invention in the United States may obtain the patent therefor in England and some other countries if he makes application before the real inventor does.

The American inventor was therefore between the devil and the deep sea. If he did not apply for his foreign patents until his United States patent was about to issue, some stranger might in the meantime apply for such foreign patents, and the real inventor's rights to such patents would be irretrievably lost. Or, if, to prevent the loss of his foreign patents he applied for them before his United States patent was ready to issue, the foreign patents might be granted first, and that would cut down the term of the United States patent. To relieve the inventor from this predicament the new law provides, in substance, that a United States patent shall remain in force for seventeen years, provided it is applied for before or within seven months after the first foreign patent is applied for. The law also provides that if the United States patent is not applied for until more than seven months after the first foreign application is filed, no valid United States patent shall be granted.

Other changes in the law are under consideration by the Patent Committees of the two Houses of Congress. Fifteen bills of importance, and more than that number which are not important, have been introduced in the House and Senate, and probably some of them, after going through the committees' hands, will come up for action during the present session of Congress. When I began to prepare this paper I intended to refer to the more important bills and thereby to provoke discussion as to their merits, but the consideration of the past and present demanded so much space and time that I was forced to abandon the consideration of the possible future. As it is, the paper is longer than I intended to make it, and I feel that I owe you my thanks for your prolonged attention. I will close with a short quotation from one of the annual reports of the Commissioner of Patents:

"The place of the Patent Office among governmental agencies is as unique as it is important. It is concerned neither with the collection nor the expenditure of the ordinary public revenues. Unobtrusive and unsensational in its work and methods, it asks nothing of the Treasury excepting moneys which its patrons contribute, and nothing of Congress excepting measures to secure its highest efficiency. As it enters upon the second century of the system which it administers, the distrust which has existed to some extent of its functions has happily passed away. The triumphs of American invention has attracted universal admiration, and the conspicuous demonstration of their importance and usefulness has turned distrust to confidence. I verily believe that no law or legal system in any age or any land has ever wrought so much wealth, furnished so much labor for human hands or bestowed so much material blessing in every way as the American patent system."

Vice United States Consul Blom writes from Copenhagen, January 9, 1899: "From conversations I have had recently with importers of rails I am of the opinion that American manufactured steel rails can compete in quality and price with those hitherto imported into Denmark from Germany and Great Britain. The railroads in Denmark use rails weighing 45 and 75 pounds per yard, and they use spikes, bolts, and fish plates, not chairs. The Danish state railroads are 1,753 kilometers and the private railroads 642 kilometers in length. Several new roads have been projected and will be built in the near future. The locomotives are all imported from Germany, but I understand that it is contemplated to send some orders for American locomotives. Manufacturers should correspond with H. C. Peters & Company, Industribygning, Copenhagen."

A FLASHLESS AND SOUNDLESS GUN.

FOLLOWING hard upon the steps of the inventors of smokeless powder comes a Frenchman who has devised a gun which, it is said, gives neither flash nor report, and which is also designed to prevent the recoil of the piece after the discharge of the projectile.

The means whereby these wonderful results are attained are the invention of a French army-officer, Colonel Humbert. The devices employed consist essentially of a perforated drum applied to the muzzle of a gun, and of a valve which is closed by the action of the powder gases upon the discharge of the projectile. The gases, thus prevented from following the projectile, are slowly allowed to escape through the perforations in the drum.

The construction of the device is shown in Figs. 1, 2, and 3, reproduced from *Der Stein der Weisen*. Figs. 1 and 2 represent the arrangement employed for large guns; and Fig. 3 illustrates a modified form of the invention.

Upon the muzzle, *A*, of the gun, the drum, *B*, is screwed. Near the forward end of the drum, *B*, a valve, *C*, is mounted. In large guns a flap-valve is used; and in small arms, a ball valve, as shown in Fig. 3. At its rear end the drum is perforated to form vent holes, *D*, for the escape of the gas after the gun has been fired.

As soon as the projectile leaves the piece, the powder gases will raise the valve, *C*, thus closing the muzzle. Being thus prevented from following the projectile, the gases, perforce, pass slowly through the vent holes, *D*.

The invention was first submitted to the French government, but was rejected. Colonel Humbert then applied to the makers of the Hotchkiss gun, and received from them a thirty-seven millimeter piece for experimental purposes.

Although the tests to which the device was subjected did not fulfill the sanguine expectations of the inven-

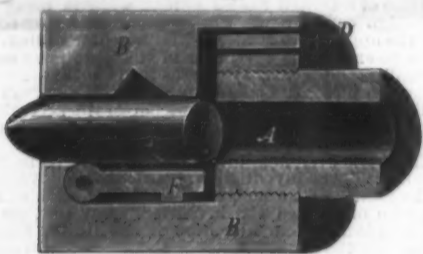


FIG. 1.

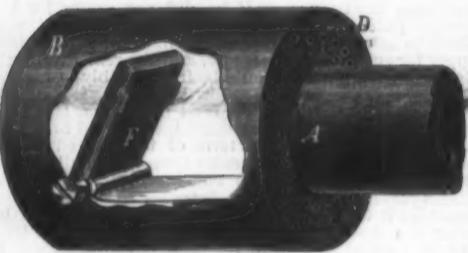


FIG. 2.

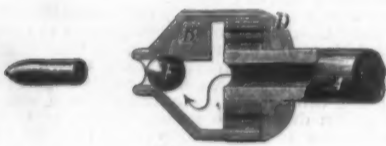


FIG. 3.

CONSTRUCTION OF THE NEW FRENCH SOUNDLESS GUN.

tor, nevertheless the results obtained were in many respects remarkable. The report was considerably muffled; but the force of the recoil remained undiminished. The powder-gases escaping from the vent-holes in the drum, rendered the serving of ammunition somewhat difficult—a fault which was later remedied by employing a casing to catch up the escaping gases.

The device of Colonel Humbert possesses many merits. It can be readily applied to any piece, without the necessity of making any great changes. True it is, that the aiming of the gun is rendered more difficult, and that in small arms the position of the center of gravity is changed; but these obstacles should be readily overcome.

Of the value of the invention in actual warfare only vague hypotheses can be made. Let us suppose that a body of troops suddenly encounter a hail of bullets from a masked battery. Several soldiers are perhaps killed; but neither eye nor ear can perceive the enemy. The commander of the troops is perplexed and helpless. Only the location of the wounds inflicted on his men by the invisible marksmen can indicate to him the position of his assailants. After he has finally discovered the place of concealment of the enemy, many of his men are killed; and he may perhaps be unable to lead an attack with his crippled force.

In the operations around Santiago, the only means by which the American soldiers could locate the position of the Spanish guns was the flash. If this should be removed, the art of war, especially on land, would become more difficult than ever; for a masked battery of smokeless, flashless, and soundless guns would be well nigh indestructible.

The rate of fire with the new piece is said to have reached a maximum of twenty shots per minute. To provide for the increased expenditure of ammunition, it is proposed to reduce a single battery from five to four guns and to augment the number of ammunition-wagons.

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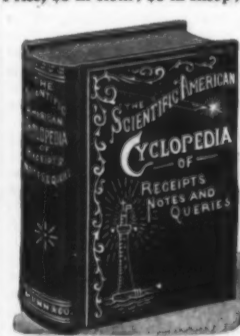
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